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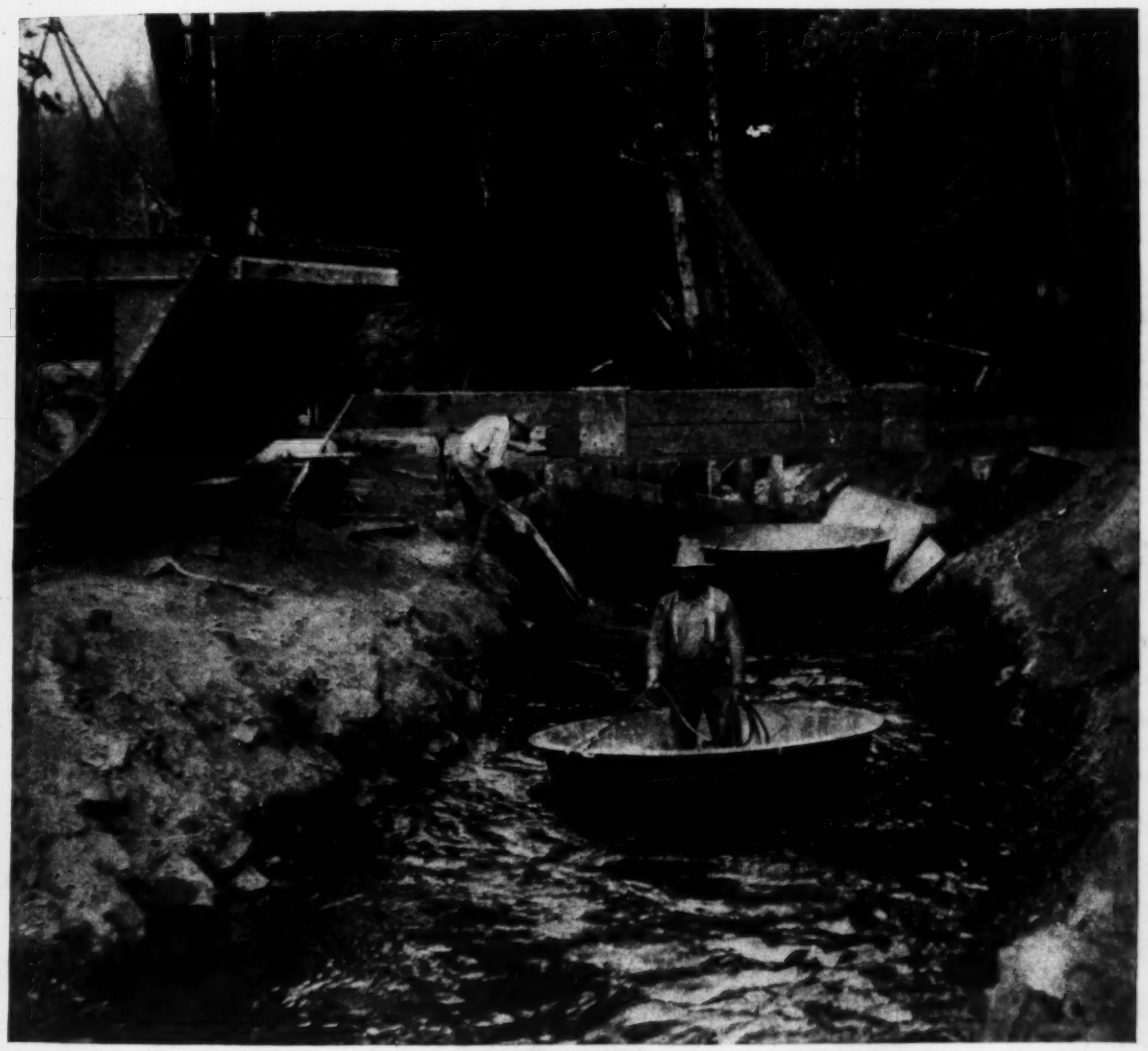
Engineering News-Record



One Man in a Tub—
Moving Material to Line a Power Ditch in California

Design of the Army's Airship Hangar at Belleville, Ill.

Recent British Concrete Road Practice; by F. Johnstone Taylor

Automobile Control, City Planning, Traffic Regulation; by Herbert S. Swan

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Hints That Cut Costs and Time for Contractors and Engineers

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 90 NEW YORK, FEBRUARY 22, 1923 Number 8

A Sensible Grandstand

AFTER the multitude of magnificent stadiums which have of late sprung up in the colleges and cities of this country, the sensible steel grandstand recently completed at the University of Iowa has a refreshing simplicity. The difference between $6 and $20 per seat in first cost is a great deal; more than enough, to our mind, to make up for the loss in beauty and monumental value the huge concrete or concrete and steel stadium possesses, especially when the added psychic value is gained at an expenditure which might well be devoted to more practical educational ends.

Shandaken Tunnel Holed Through

LAST week witnessed an important stage in the completion of the Schoharie development of the Catskill system for the additional water supply of New York City. The last pair of headings in the 18.1-mile Shandaken tunnel through which water impounded by the Gilboa dam will flow by gravity into the Ashokan reservair and thence, through the Catskill aqueduct, to New York, was holed through early in the morning of Feb. 13, opening up continuous stretch of hard rock tunnel 95,740 ft. long which, when lined with concrete, will have a horseshoe cross-section 11 ft. 6 in. by 10 ft. 3 in. and a capacity of 600,000,000 gal. daily. The Shandaken tunnel takes rank as the world's longest continuous tunnel, exceeding by the slight margin of 51 ft. the city aqueduct tunnel (95,689 ft.) for the delivery of Catskill water within the city limits. The contract for the Shandaken tunnel was awarded Nov. 9, 1917, but on account of conditions arising out of the war progress was interrupted and the work did not get into full swing until the beginning of 1921. From that time, however, the headings from six shafts and one portal have advanced rapidly until the final wall of rock in the 120 miles of waterway between the Schoharie reservoir and the City Hall, has been blasted away. Even with the additional water available in New York by the development of the Esopus and the Schoharie sources the problem of the city's ultimate supply is not solved. Each year brings increased demands for water and even now, with the completion of the second phase of the original Catskill project in sight, investigation of supplementary sources are in progress. In water supply—as in other fields of engineering—it is necessary to plan far ahead.

Transit Again Active

RAPID-TRANSIT questions are again stirring in various cities. Since the war there has been little real interest in the subject, for cities and citizens have been kept so busy in trying to make ends meet that they have had no time left to make plans for costly improvements. But the need for transportation is steadily becoming more urgent, and with the present more promising outlook for municipal finance the transit problem again takes a leading place. Philadelphia, five years after stopping work on its Broad St. subway trunk line, is about ready to continue, and would be actively preparing for work were it not that the city council has just revoked the earlier authorization to build the subway. The measure is apparently political, and is bound to cause great loss to the city if it is allowed to delay work very long. Rapid-transit construction in Philadelphia may be considered a matter of the early future. In Pittsburgh, where a hastily planned loop subway for street cars was approved by referendum some years ago, and a $6,000,000 bond issue voted for its construction, nothing has been done since that time to build such a subway, and the city now finds a large part of its credit tied up by the subway vote. Abrogation of the bond issue vote is now being agitated; it will bring the city one step nearer rapid transit, for traffic downtown is concentrating and slowing up, as elsewhere. Detroit is in a more advanced condition: it is just entering upon a genuine study of transit possibilities. Having the most difficult geographical problem, because of its large and widely scattered territory, it enjoys the advantage of owning its street car system, and thus is not hampered by the problem of arranging for operation, which is a disturbing factor in such communities as Cleveland and Philadelphia. The present-day transit planning, however, is not merely a resumption of former planning, for conditions have changed much by the increase of automobile traffic since the transit problem last engaged general attention. The correlation of rapid transit and surface traffic problems has hardly yet been approached, but it is sure to claim attention within the next year or two. With planning thus active, it is hardly to be doubted that definite action toward rapid-transit construction in at least one or two cities is not far ahead.

A Neglected Obligation

LAST week the American Society of Civil Engineers devoted an evening to the presentation of a paper on the design of reinforced-concrete columns attacking the "excessive and therefore unsafe stresses" permitted by the Joint Committee specifications of 1917 and 1921 on the basis of a long scholastic investigation of test results. Though the paper was by a non-member, who has not hitherto had any prominence as a student or investigator in reinforced concrete, the paper had been published in the "Proceedings" of the society and had thus been given permanent standing in engineering literature. As a unique study of a somewhat standardized subject and as an attack on commonly accepted methods of design this paper deserved an adequate discussion which it did not receive. The meeting was poorly attended, and those who commented on the paper contented themselves with generalities about concrete and columns rather than discussion of the unconven-

tional magnification of the theory of error as applied to tests, which is the critical issue in the paper. The Joint Committee has, we believe, entered into a solemn pact not to discuss publicly any of the provisions of its specification, which may account for the fact that none of the society's representatives on that committee spoke on the paper. If this is so, it is only another instance of the unwisdom of the committee's policy of silence, because an unanswered criticism is apt to become an unanswerable criticism, particularly when it is dignified by the use of 75 pages of the "Transactions" of the American Society of Civil Engineers. Will not the Joint Committee relax its regulation in time for the written discussion?

Organized Discussions

ANOTHER thought arises from this incident. Discussion at technical meetings must be organized and fostered. There is a long-held fallacy that a good —or a bad—paper will bring out its own discussion. Hundreds of apathetic technical meetings have proved this fallacious. Those best fitted to discuss a given subject are least apt to volunteer their opinions; too often to them it is old straw that will not stand rethreshing. They need some centralized urging that their opinions are worth while and that, though their views may be hackneyed to the expert few, they are novel and interesting to the many who lack the expert knowledge. The American Society of Civil Engineers can do much to improve its regular monthly meetings by some direction of the discussion, by some attitude other than the conventional one that the very fact that the society has accepted and printed a paper is sufficient urge to the oral discussion. The only excuse for the monthly meeting, now that the social feature has become so atrophied, is a live discussion; and, frankly, the discussions of late in these meetings would discredit the weakest local society, so scattered and meager have they been. Some organized planning is obviously required.

St. Louis Bond Election Significant

THE TWENTY-ITEM $87,372,500 bond issue authorized Feb. 7 by the voters of St. Louis will finance the largest, most varied and best planned program of municipal improvements ever attempted by an American city. The largest municipal bond issue heretofore authorized by popular vote appears to have been $51,750,000 for a variety of improvements at Baltimore, Nov. 2, 1920 (*Engineering News-Record*, Oct. 28 and Nov. 11, 1920, pp. 866 and 960). That twenty items should have been approved at St. Louis and only one defeated is all the more remarkable because majorities were well in excess of the necessary two-thirds, the affirmative votes running as high as 86 per cent of all the votes cast for the $12,000,000 of water-supply extension bonds.

The St. Louis program is the result of several years of study and campaigning with extensive and highly commendable co-operation between the city officials and various civic organizations, the latter functioning through a large joint committee. After quite extensive investigations, a $24,000,000 bond issue of 18 items went to popular vote on May 11, 1920, but of these only five, totaling but $3,815,000, received the necessary two-thirds majority, although every item had a substantial excess of one-half of the votes cast, the yea votes ranging from 62 to 69 per cent of the total. Not daunted by the failure of 12 of 18 items and a much larger percentage of the total amount of bonds proposed, study was soon begun on the much more comprehensive program just adopted, the items at the 1920 election having been chosen from those considered most urgent, in view of the generally unfavorable conditions of that time. Many of the items defeated in 1920 are included, some with enlargements, in the bond issues just authorized.

Although 20 of the 21 items and all but $1,000,000 of the $88,372,500 submitted at the recent election carried by more than the necessary two-thirds, the majorities ranged from about 65,000 to 35,000 in a total vote averaging 90,000. The five highest majorities were waterworks, hospitals, fire department, sewers and grade crossing elimination, and the five lowest (also in order of decreasing majorities, were railway approaches to the free municipal bridge (two items), municipal auditorium, municipal plaza and hall, and an aquarium in Forest Park. The highest and lowest majorities (of the 20 items carried) were for the largest and smallest items, $12,000,000 for water-works and $400,000 for the aquarium already mentioned. This is another illustration of discrimination in voting, and of the fact that it was the object rather than the amount of the item that counted.

There is food for reflection in the fact that less than a third of those entitled to vote went to the polls. In the 1920 election about 44 per cent of the registered vote was cast, but the total registration of 1923 was much larger than that of 1920, on account of the subsequent extension of the suffrage to women.

Altogether, the results of the St. Louis bond election are most encouraging. They show that a well-framed program of municipal improvements, brought home to the understanding of the voters, will be endorsed even in this time of high construction costs and relatively high bond interest rates. They also show that under such conditions an item-by-item vote is no more and probably less of a risk than voting on a lump sum. With a bond market eager for municipal securities and the St. Louis results in view, other municipalities may well be encouraged to frame and submit similarly well-considered bond-issue programs, for most cities and towns are far behind on much-needed construction.

A Start on Departmental Reorganization

THE reorganization of the departments at Washington, like every major reform, moves slowly. It is four years since the engineers of the country got together to promote the idea of a Department of Public Works consolidating all the engineering functions of the government, and as a co-ordinate reform the reclassification of all the government bureaus for more economical control. It is nearly two years since President Harding appointed the Brown commission to prepare a plan which would bring about this reform. The engineers' activities did not persist very long, mainly because it soon became evident that the Brown commission was working along the lines suggested by the Department of Public Works idea and that if the reform came it would have to come from the inside through the medium of that commission. The administration plan, labored over for two years, fought out at the Cabinet table and, if rumors be true, the cause of one

resignation from that body, and fairly wrung from the reluctant department and bureau heads, is now made public. It goes to a busy Congress, engrossed in a multitude of things undone, and stands little chance of consideration for a year unless, perchance, the President is forced to call an extra session.

On the ground that what should be done had best be done quickly it is too bad that the commission could not have completed its work last summer so that the present Congress could have taken action. As it is, however, there is a long time for the plan to be studied, not as a suppositious project but as a definite program with all the weight of the administration behind it.

While the Brown proposal is much wider in its concept than that proposed by the engineers a preliminary study shows that it covers most of the changes advocated for the Department of Public Works. To be sure there is no new department of that name or even a change to that name of an old department, but under the Department of the Interior are grouped most of the engineering activities of the government or at least those engineering activities not specifically a part of the operation of one of the other departments. The army and the navy still retain the engineering work peculiar to their needs, which is rational and desirable, and give up those activities which are strictly of a civilian nature.

Under this latter classification comes the relinquishment of the river and harbor work by the Corps of Engineers, which will doubtless prove the greatest bone of contention in the plan. This change is rational, too, but it will not be complete unless some definite scheme is enforced whereby the officers of the corps are given responsibility in varied lines of engineering so that when war comes they will not only have engineering experience but the mental poise and backbone that only responsibility confers.

No one need believe that any scheme for reorganizing the departments at Washington will have easy sledding, much less one which involves such wholesale shifts as this one. Probably a reorganization bill that emerges from committee will bear little resemblance to the plan which the President presents, but at least we are nearer a solution of the confusion that now exists than ever before. Bearing in mind the changes that Congress will probably impose, there is no need now of spending too much time analyzing and discussing the present proposal, but it can be said that it is a good start toward a reform in government engineering practice that should benefit both the government and the engineers who serve the government.

Political Road Control

NEW JERSEY with $20,000,000 to spend on roads this year has made the administration of its highway department an issue of partisan politics. Incidentally the state since Jan. 22 has been without a responsible head of its road-building activities. These facts possess a disquieting significance not confined to the effect on highway development in the single state directly concerned. They exemplify a reversion of thought on public roads work which is being manifested in many states and which if it not checked may undo much that has been accomplished in the last few years toward putting state highway administration on a fairly high plane. They point to the necessity of organized corrective effort akin to that which created the demand of the last few years for road improvement.

Considering the New Jersey situation specifically, there will be few mourners for the old, eight-man, bipartisan highway commission. The smaller commission of four, provided by the new law, although it is still bipartisan, is a much preferable working organization. One may commend also the personnel of the new commission as it has been named for confirmation. There is no great cause to criticize any of the minor provisions of the new law and some of them can be praised. All this granted, the fact remains outstanding that the law is purely the creation of partisan politics. Not one provision, from the bipartisan requirement to the number of commissioners and the appointive power, was decided on any basis except compromise between a democratic governor and a republican legislature.

The calm assumption by the executive and the legislature of the right to discuss and arrange the highway business of New Jersey as a political issue and the complacent acceptance by the public of this assumption, constitutes today the hazard to highway development which thoughtful engineers most fear. The condition is not peculiar to New Jersey; it exists in a number of other states where, however, it is not quite so bold in displaying itself naked to the world.

The discouraging truth is that all over the country a determined effort is being made to swing the great work of roadbuilding into the list of public activities which proceed under political favor. Power has been lent to those who seek this goal by an economic condition which has set the people astir to ease their burden of high taxes and high costs. Watching their highway bills pile up to hundreds of millions a year, taxpayers are in a fit temper to follow the leader who promises relief by calling back the old regime of local direction and control. Such leaders are not lacking and they are getting followers in exactly the degree that the people have not been educated in the highway business.

Following a period of active education of the public to the need of good roads there has been a period of no schooling. Rampant propagandists as they were in large part, the old "good roads" organizations accomplished their object of creating an active public sentiment for improved highways. With the first lesson taught education ceased. Federal and state highway departments and associations of roadbuilders have taken up educational work only as it has concerned the technique of highway building and operation. Their work has been remarkable but, with rare exceptions, they have done little to teach the people generally the business of highway engineering and highway transport. There is need for some one to perform this task.

Few would care to see repeated the methods of the old "good roads" boomers, but a revival of their spirit would do much to change the present situation which is worrying federal and state highway officials. They are largely helpless because of the laws which control their activities and define the objects for which they may spend public funds. Educational propaganda is not one of these objects. This work must be inaugurated and advanced by the engineering and industrial associations concerned with highway development. It should be made a major item of their programs as soon as they can function officially to do this.

Huge Airship Hangar for U. S. Army: Scott Field, Illinois

Three-Hinged Trusses on Side Bents for Structure 206 x 810 Ft., 162 Ft. High—Large Timber Traveler—Motor-Operated Rolling Doors—Towing Trolleys

By Hilmar F. Smith

Late Supervising Engineer, Quartermaster Corps, U. S. Army. (As noted in *Engineering News-Record*, Jan. 18, 1923, p. 137. Mr. Smith died Jan. 6, 1923.)

TYPICAL of the great steel-frame buildings which have been developed in recent years for housing airships is the U. S. Army hangar or shed which has been completed recently at Scott Field, near Belleville, Ill. This immense shed is 810 ft. long and 206 ft. wide, with a clear interior height of 150 ft. at the center. Its main framing consists of a row of three-hinged arches seated on A-frame bents which form the lower portions of the sides. The ends are closed by rolling doors. Docking rails and conduits extending through and beyond the building carry manually-operated trolleys to which cables are attached for towing the airships in and out. To meet the conditions of prevailing direction of winds, the center line of the hangar lies 5 deg. east of true north. A general view of the building with its rolling doors partly open is given in Fig. 1.

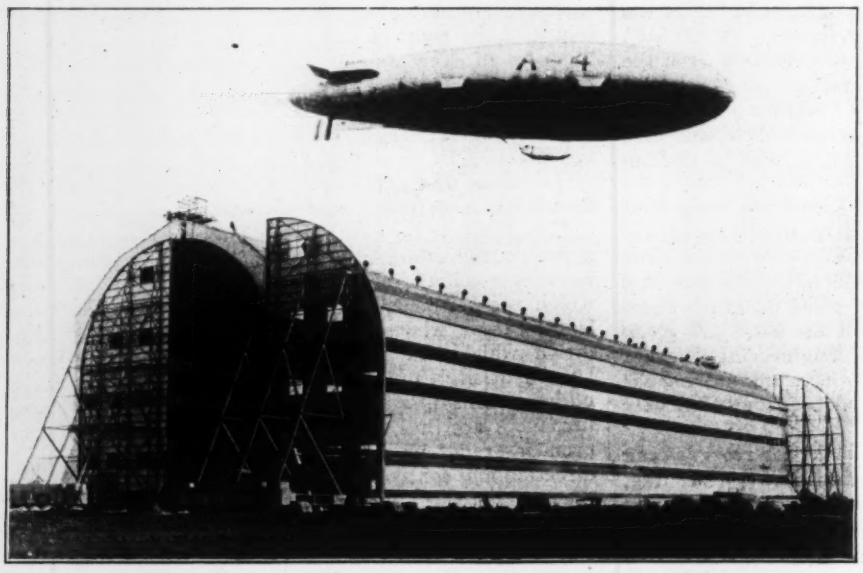


FIG. 1—U. S. ARMY AIRSHIP HANGAR AT SCOTT FIELD, BELLEVILLE, ILL.

An electrolytic hydrogen-gas plant is an important accessory. It is located 1,400 ft. from the hangar and has a gas-holder of 500,000 cu.ft. capacity. Other auxiliary works include: (1) An oil-cracking plant which also houses a 50-hp. boiler for heating the gasholder; (2) a boiler house 200 ft. distant to supply low pressure steam for heating the enclosed rooms of the hangar; (3) a sewage ejector station of 100 gal. capacity per hour, discharging to the sewer system of the military post, 2,000 ft. distant; (4) 3,000 ft. of electric conduit delivering 2,300-volt current to a substation for supplying power to the hangar and gas plant, and (5) 3,700 lin.ft. of 16-ft. road paved with bituminous macadam.

Foundations—Along each side of the building there are two rows of footing pedestals, spaced 27 ft. 6 in. c. to c., to carry the inner and outer legs of the A-frame side bents. The inner rows are 75 ft. 9 in. from the center line or 151 ft. 6 in. apart. These footings carry the steel bents of the sides and are rectangular in plan, approximately 15 x 7 ft. at the base, with the larger axis transverse to the building. They are designed for a maximum soil bearing of 4,000 lb. per square foot. No piles are used for the foundations.

At each end of the building are heavy reinforced-concrete foundations for a pair of standard-gage tracks 50 ft. c. to c., carrying the rolling doors. Each track has rails anchored to a concrete stringer 12 ft. wide and about 6½ ft. deep, these stringers being connected at intervals by cross walls. Concrete bumper posts limit the travel of the doors. Along each side of the building and across the narrow closed portion of each end is a curb wall on which the siding or sheathing rests. This curb also forms one side of a concrete gutter carrying roof water to the storm-water drains.

Steel Frame—The main structural framing consists of twenty-eight three-hinged arch trusses spaced 30 ft. c. to c. and resting on A-frame bents carried by the pedestal footings. At the apex of each bent, 48 ft. above the floor, is the 4-in. shoe pin of the truss, the span c. to c. of pins being 160 ft. The 3-in. center pin is 162 ft. above the floor. A typical cross-section showing the trusses and bents is given in Fig. 2. Parts of the framing plans, elevations and sections are given in Fig. 3. The inner legs of the A-frames and the bottom chord of the truss conform closely to a clearance line vertical for 75 ft. on each side and then forming a circular curve of 75 ft. radius. The end trusses carry packing plates cut to this curvature, as shown.

Two lines of longitudinal struts connect the bents, one of these being in a vertical plane and the other in a horizontal plane. Three struts in a horizontal plane connect the vertical portions of the trusses along each side. Four struts in vertical planes and spaced about 20 ft. apart connect the arched portions of the trusses. Two of these upper struts carry trolley runways and are designed for an additional live load of 2,000 lb. The location and construction of the struts is shown in Fig. 3. In 10 of the 27 bays there is bracing to connect the trusses in pairs. In each bay

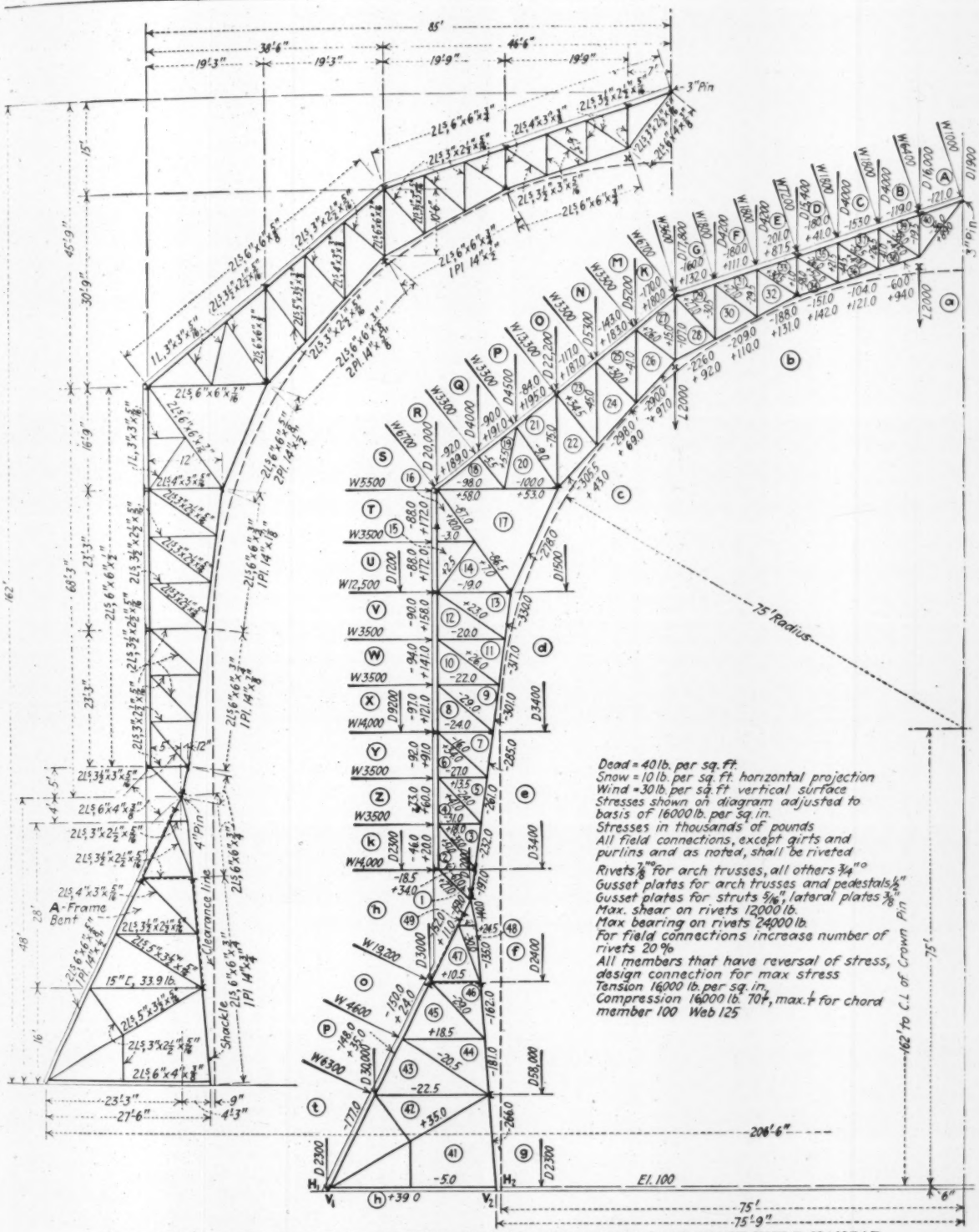

85'
38'6"
46'6"
19'3"
19'3"
19'9"
19'9"
3" Pin
75' Radius
A-Frame Bent
Clearance Line
4" Pin
Shackle
15" I, 33.9 lb.
Dead = 40 lb. per sq. ft.
Snow = 10 lb. per sq. ft. horizontal projection
Wind = 30 lb. per sq. ft. vertical surface
Stresses shown on diagram adjusted to basis of 16000 lb. per sq. in.
Stresses in thousands of pounds
All field connections, except girts and purlins and as noted, shall be riveted
Rivets 7/8" for arch trusses, all others 3/4"
Gusset plates for arch trusses and pedestals 1/2"
Gusset plates for struts 5/16", lateral plates 3/8"
Max. shear on rivets 12000 lb.
Max bearing on rivets 24000 lb.
For field connections increase number of rivets 20%
All members that have reversal of stress, design connection for max stress
Tension 16000 lb. per sq. in.
Compression 16000 lb. 70r, max. l/r for chord member 100 Web 125
162' to C.L. of Crown Pin
75'
El. 100
206'6"
75'
75'9"

FIG. 2—TYPICAL CROSS-SECTION OF ARCH TRUSSES AND A-FRAMES IN SCOTT FIELD HANGAR

the struts carry intermediate framing consisting of an I-beam rafter to support the roof purlins and I-beam posts in the sides to support the girts.

Expansion movements are provided for by 1½-in. slots in connections at trusses Nos. 7, 13, 16 and 22. Three main stairways afford access to three longitudinal walks under the roof, connected by three transverse cat walks. The roof was designed for a snow load of 10 lb. per square foot (horizontal projection) and a wind load of 30 lb. per square foot (vertical section).

Steel Erection—There are 3,200 tons of structural steel in the building. Special equipment was required for the erection of so lofty a structure. Each half-truss was shipped in four sections: (1) The vertical portion

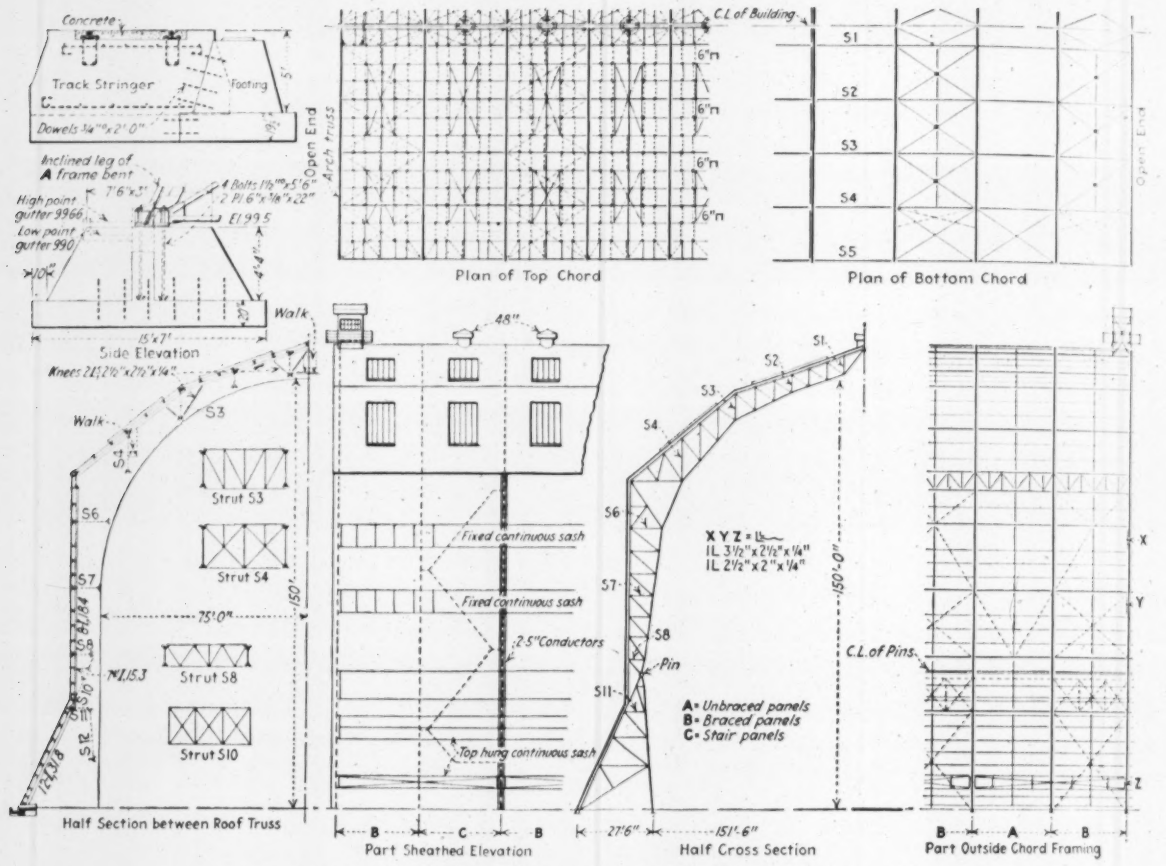


FIG. 3—FRAMING PLANS, ELEVATIONS AND SECTIONS

from shoe pin to eave line, 63½ ft. long; (2) the bottom chord tie between this and the next section; (3) the section from eave to hip line, with a pitch of 9⅛ in. per foot, and (4) the section from hip to peak, with a pitch of 3⅛ in. per foot. Two standard-gage tracks, 100 ft. c. to c., were laid along the site, each track 50 ft. from the center line. Between these tracks was the erecting traveler constructed of heavy timbers, as shown in Fig. 4. Prior to the erection of the traveler all the A-frames were placed, with the intervening struts to tie them together. Upon completion of the traveler, at the north end of the site, the trucks for the north doors were set on their tracks and the steel framing was erected for these doors in their closed position. In this way a definite tie was available for the first truss. The traveler then moved back, erecting the trusses and framing as it proceeded.

Truss erection began with hoisting the 6-ton plumb section of truss into position by means of a derrick boom on top of the traveler. There it was pinned and held in position from the outrigger platform of the traveler by setting the truss section in a slot formed by overhanging timbers clamped to the outrigger platform. Then the 1½-ton bottom chord tie was erected. The two upper sections of truss were riveted together on the ground and the complete 9-ton section was then raised into position, the top pin being driven when the two half trusses were swung into place, both sides being erected simultaneously.

Tracks on either side of the traveler permitted the

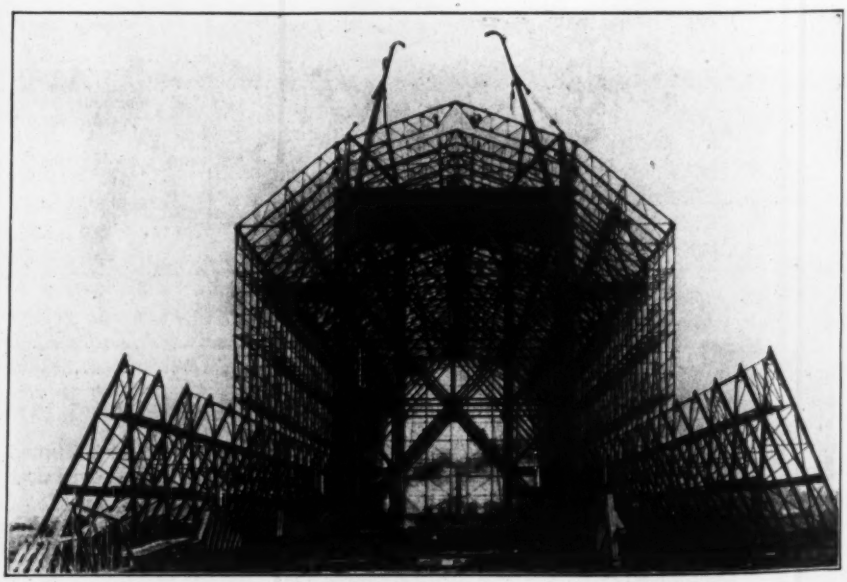


FIG 4—ERECTION TRAVELER IN U. S. ARMY HANGAR

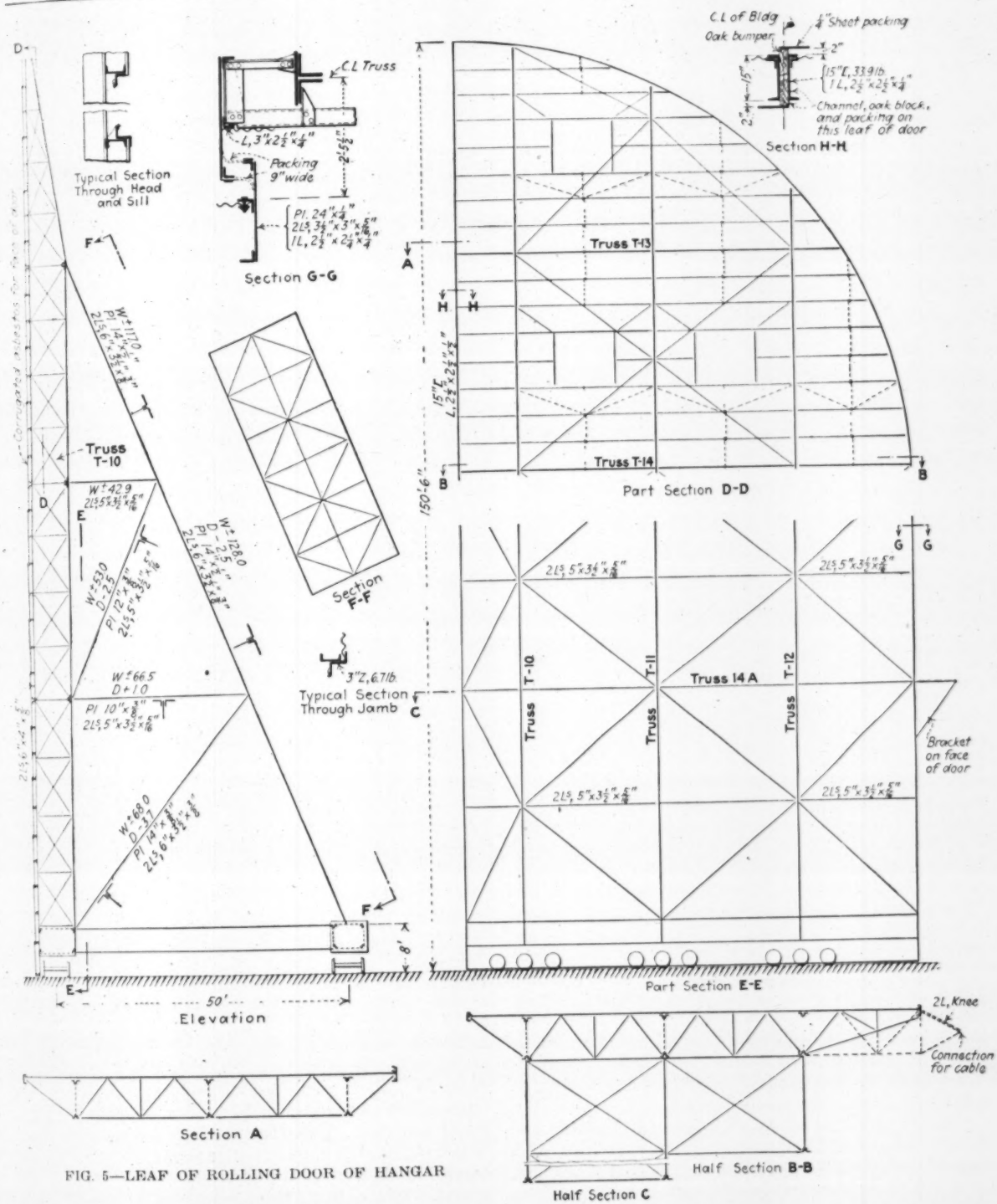


FIG. 5—LEAF OF ROLLING DOOR OF HANGAR

operation of two derrick cars for feeding steel on either side, thus keeping both sides up to the same rate of progress. At the south end the traveler was backed out of the building and clear of the south door tracks in order to erect the south doors, a 120-ft. boom being fitted to one of the derricks for this work.

After the first two trusses had been erected and the first bay filled in, no difficulty was experienced in handling this equipment for the steel erection. In a 44-hour week erection was at the rate of three trusses with bays filled in, or an average of approximately 50 tons daily. The last five trusses were erected in about a week, but scant attention was paid to fitting up as the pace was rather too fast. Fig. 4 shows the traveler, with several of the trusses erected on the A-frame bents.

Traveler—In this huge erecting structure, the general construction of which is shown in Fig. 4, the posts were built up of two 6 x 10-in. timbers, except that the two posts carrying the derrick masts were composed of pairs of 8 x 12-in. timbers. Cross-struts were pairs of 4 x 10-in. pieces in the upper half and 6 x 12-in. in the

lower section. Tension diagonals were 3 x 10-in. and stiff diagonals two 6 x 10-in. and 10 x 10-in. Timbers doubled in this way permitted the use of steel gusset plates in a very convenient manner for bolting at all points. Longitudinal struts capped the posts in each section and were 10 x 10-in. timbers, except that the sills were 10 x 12-in. The outriggers consisted of brackets of two 6 x 10-in. timbers with 3 x 12-in. joists and a 2-in. plank floor. The top deck of the traveler proper was similarly constructed.

On each side of the top deck was a steel stiff-leg derrick with hoisting capacity of 1, 2 and 15 tons for 84-, 74- and 60-ft. lengths of boom. These booms had goose-neck ends, as shown, to give greater reach. For

Skylights 16 ft. wide are placed one above and one below the hip, on either side of the ridge, a sheet of actinic wired glass being built in each tile in this area, which extends the length of the building. Under the skylights are diamond-mesh wire screens as a protection in case of breakage of the glass. Two runs of fixed sash 8½ ft. high are placed on either side, located between the eave and lower pin connection. Three runs of 5-ft. movable sash are located in the rake below the shoe pins. Each door leaf has nine sash panels. Actinic wired glass ¼ in. thick is used throughout.

On each side of the building is a 10-in. square box gutter hung at the eave, carrying water from the roof to seven pairs of 5-in. downspouts discharging

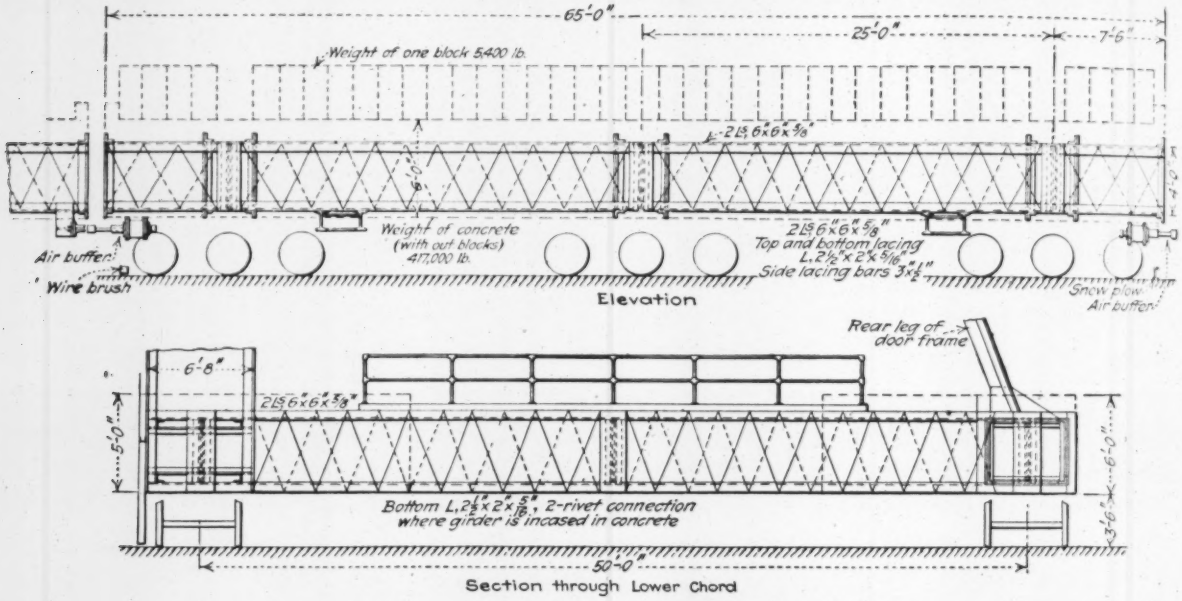


FIG. 6—BASE GIRDERS AND TRUCK ARRANGEMENT OF DOOR

the operation of this traveler, three hoisting engines were required: (1) A hoist with two drums for load at 60-ft. boom and for topping lift, and two spools for swing lines to rotate the boom for derrick No. 1; (2) a similar hoist for derrick No. 2; (3) a hoist with two drums for the runners on the two derricks, the runners handling light loads at 80-ft. boom. The traveler itself was mounted on movable sections of rail laid 80 ft. apart. It was moved by two sets of blocks and tackle anchored in the direction of movement and wound on the spools of the hoisting engines.

Sheathing and Sash—All siding on the building and the end doors is of corrugated sheets consisting of a core of metal of No. 24 gage dipped in hot asphalt, on which an asbestos protective coat is rolled on both sides, the sheet then being painted with a protective coating of aluminum color. On vertical seams the sheets are bolted at 18-in. intervals. Horizontally they are strapped to the girts at every third and eighth corrugation with cupped sherardized bolts and galvanized iron straps. These girts are approximately 4½ ft. apart. At expansion joints a 16-oz. copper roll is used. Concrete tiles 2 x 4½ ft. are used for the roof, on purlins 4 ft. apart. Every tile is fastened to the purlins with copper wire and clips to eliminate the remote chance of a strong wind lifting them out. into an open concrete gutter having three 12-in. drains to the storm-water system. On the ridge are twenty-five ventilators, 48 in. in diameter. The floor is a 4-in. concrete slab on a 16-in. tamped cinder fill, and is covered with 1 in. of mastic.

End Doors—At each end of the hangar is a pair of self-supporting rolling doors which cover the entire height and width of the structure. Two of the leaves are shown in the open position in Fig. 1. Each leaf or half-door, Fig. 5, is composed of vertical and horizontal trusses, braced together and carrying a facing of corrugated asbestos. This framework is supported by tall A-frames, as shown. The entire structure of the leaf is carried by six-wheeled trucks on two standard-gage tracks spaced 50 ft. c. to c., these tracks being transverse to the center line of the hangar and laid with 80-lb. rails. The four corner trucks are fitted with electric motors and the two others are idlers.

Heavy framing is used for the base of the doors, as shown in Fig. 6. Cast steel bolsters on the trucks carry latticed box girders, the one nearer the building being 75½ ft. long and 6 x 6 ft. in cross-section, and the other girder 65½ ft. long, of similar cross-section. Each girder rests on three trucks spaced 25 ft. apart. These two girders are tied and cross-braced with built-up latticed I-girders. On the long girder is carried the

structural steel door superstructure, back braced to the rear girder by the A-frames. This superstructure is similar in outline to half the end opening and carries sheathing to cover its share of the end of the building.

There are approximately 135 tons of steel in a leaf, and this weight is increased by 200 tons of concrete in each main girder, besides 100 tons of movable concrete counterweight blocks placed on top of the rear girder. This brings the total weight of a door leaf to over 600 tons. The purpose of the heavy counterweighting is to resist the overturning tendency when the leaf is open and exposed to wind pressure.

In the design of the door the following loads were used: Live load is based on 30 lb. per square foot. Dead load includes the weight of the structure and counterweights but does not include the weight of the trucks and operating mechanism.

1. Total vertical dead load per truck: 205,600 lb.
2. Total vertical dead and live loads on the three leeward wheels per truck; 196,900 lb.
3. Total vertical dead and live load on the three windward wheels per truck; 145,900 lb.
4. Total horizontal live load per truck; 64,000 lb., which is resisted by the flanges of the three leeward wheels in contact with the rail head.

Door Operation—The trucks carrying the doors have 2-in. armor-plate side frames and 33-in. cast-iron wheels with chilled treads, with a wheelbase of 9 ft. On each motor truck (four per leaf) the axle at one end is driven by gearing from a motor and power is transmitted to the middle axle by coupling-rods on the wheels. The 250-volt motors are rated at 27½ hp. and it is calculated that 45 hp. per motor will be required in starting and 6 hp. when running at the rate of 10 ft. per minute. All four motors are operated in parallel through a master switch located in a small control house on the door platform.

When opening, the door leaf may be stopped in three ways: (1) By a limit switch tripping the circuit breaker in the control house; (2) by pneumatic buffers on the truck frames striking the concrete bumpers; or (3) by throwing off the master switch, which releases the solenoids on the motor pulley brakes, strong springs holding the brakeshoes against the pulley. The truck buffers are plungers working in pneumatic cylinders. When closing the doors, each leaf is stopped by means of cast-steel blocks bolted to the rails. As the leaf reaches its closed position, these stops engage brakeshoes suspended from the truck frame and bring these shoes in contact with the wheels.

In emergency, the doors may be moved by means of a hand operating mechanism designed to obtain a speed of at least one foot per minute. A capstan for eight 10-ft. handles is mounted on the center of the door platform, a 4-in. reinforced-concrete floor permitting manning and operating of the capstan. The capstan head is geared to a vertical shaft whose lower end carries a bevel pinion transmitting the power through bevel gears to two cross shafts which are in line with each other and each of which carries a drum on which is coiled a 1-in. plow-steel cable.

To operate the doors by hand, the two drums of each leaf are released from their shafts to allow them to revolve freely, so that the cables can be hauled off and attached to deadmen or anchors at the end of the track. With the drums again keyed to the shaft they are driven by means of the capstan, the door being hauled on the track as the cables wind on the drums.

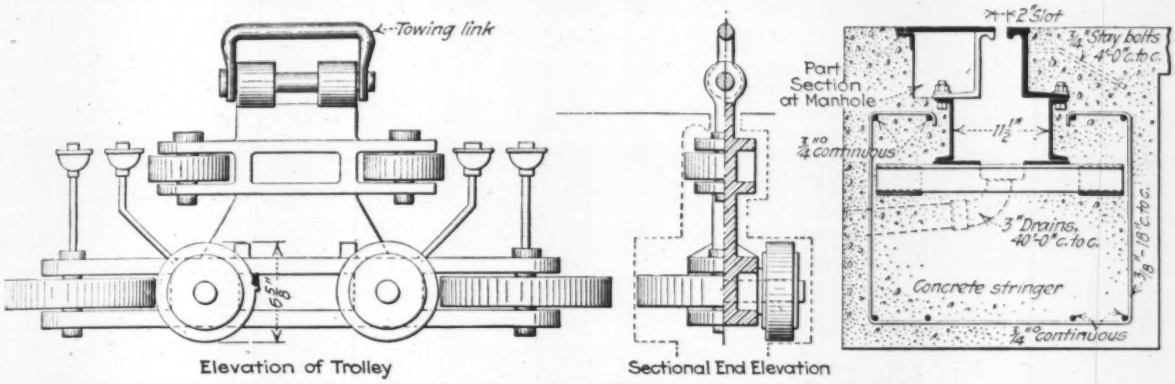


FIG. 7—DOCKING CONDUIT AND TOWING TROLLEY FOR HANGAR

Where the docking-rail conduits cross the door tracks there are installed manganese steel crossovers which close the 2-in. gap in the docking rail by means of two movable rail sections. Added protection is provided by an electric switch which trips the door feeder circuit in the substation should the movable section of rail be ⅜ in. out of place. Power is brought to the door motors through an armored flexible cable suspended from a 40-ft. steep pole to an outrigger on the door (Figs. 1 and 5).

Docking Rails and Trolleys—Airships will be towed in and out of the hangar by trolleys traveling in longitudinal conduits, each trolley having a towing link which projects through a 2-in. slot in the floor of the hangar. Towing cables attached to the airship are hitched to the trolley by means of a cable-releasing device. There are eight trolleys in all and they are handled by men by means of tow ropes. In this way the airship is prevented from getting away when once secured to the underground trolley.

There are two of these conduits 137 ft. apart and 3,610 ft. long, extending 1,400 ft. beyond each end of the 810-ft. hangar. As shown in Fig. 7, the conduit is formed by a pair of 7-in. channels with base plates, tied together at the bottom by transverse angles. Upon these channels are two 8-in. 81-lb. slot rails, forming a 2-in. slot in the floor of the hangar. This whole steel structure is embedded in a reinforced-concrete stringer, the slot rails being held in position by diagonal rods with anchor plates. The trolley or towing carriage has four 6⅝-in. wheels riding on the bottom plates of

the conduit and is held in upright position by horizontal guide rails riding against the sides of both the wide and narrow portions of the conduit. All these wheels have roller bearings. A manhole at each end of the docking rail provides for removal of the trolley. Manholes for oiling are spaced approximately 150 ft. apart.

Heating and Lighting—Along the sides of the building, between the A-frames, are twelve rooms 60 ft. long, 16 ft. high and 22 ft. 6 in. wide, with 2½-in. metal and plaster walls. Approximately 400 sq.ft. of ceiling type radiation is required for heating these rooms, low-pressure steam being supplied from two sectional boilers in the boiler house. For artificial lighting there are seven rows of lights running the length of the building, with a 200-watt lamp and 16-in. reflector in each bay per run. In addition, there are 250-watt projectors, 16 ft. above the floor, on all the A-frames except those at the ends, making a total of fifty-two projectors. Eight 200-watt flood lights are on the gable at either end of the roof. In addition, at each end of the peak of the roof is a lookout house, 7½ x 15 ft., surmounted by a platform carrying a 36-in. searchlight.

Gasholder—For the gas plant, the hydrogen tank is a 500,000-cu.ft. triple-lift holder, with water tank approximately 100 ft. in diameter and 26 ft. high. This water tank rests on a heavy concrete foundation, and carries a guide frame 75 ft. high on column supports riveted to the sides. Each lift is approximately 25 ft. high and, when inflated, the pressures are 5 in. of water for one lift, 6½ in. for two lifts and 9 in. for three lifts. There are approximately 400 tons of steel in this structure. A 50-hp. boiler at 100 lb. pressure furnishes steam to protect the tank in freezing weather. There is a 16-in. inlet and a 16-in. outlet, the latter reduced to 10 in. to supply hydrogen to the 10-in. pipe line extending 1,400 ft. to the hangar. On this pipe line is a meter with a capacity of 35,000 cu.ft. per hour. A concrete trench protects the 10-in. hydrogen, 2-in. air and 22-in. water lines inside the hangar.

Construction Work—The main structure is practically completed, but the 2,300-volt incoming electric line, the substation, gas plant and oil-cracking plant will probably be completed this month. Construction was done for the Air Service by the W. M. Sutherland Building & Contracting Co., St. Louis, Mo., under supervision of the Construction Service of the Quartermaster Corps, U. S. Army. Steel erection of the hangar was handled by the Strobel Steel Construction Co., Chicago. The total cost of the entire plant will be about $1,400,000, of which the hangar represents $1,250,000.

Drawbridge Pier Destroyed by Steamer

An extraordinary accident in which the rest pier of a single-leaf bascule bridge was demolished, occurred in England on Dec. 17. The bridge has ten girder spans and a bascule lift span carrying a highway and the Southeastern & Chatham Ry. over the river Swale. The clear width of waterway is 58½ ft. and as the 7,000-ton steamer "Gyp" was about 48 ft. wide the owners were warned of the risk in taking so large a vessel through the draw. In some way the steamer got beyond control and struck the rest pier with such force as to knock it over, leaving the adjacent fixed span standing as a cantilever, as shown by photographs in the *Railway Gazette*, London. The extent of damage to the ship is not reported.

New York State Highway Construction

THE following figures, which set forth the present status of New York state highway construction, were presented by John H. Gordon, president of the New York State Roadbuilders' Association at its annual banquet held recently in Albany.

Work completed in 1922 that was awarded in:	
1919	$352,000
1920	301,000
1921	8,561,000
1921 (repairs)	1,653,000
1922	4,697,000
1922 (repairs)	764,000
Total completed during 1922	$16,328,000
On Jan. 1, 1923, there remained to be completed, work awarded in:	
1919	$40,000
1921	1,787,000
1922	11,645,000
1922 (repairs)	2,020,000
Total remaining to be done, as of Jan. 1, 1923	$15,492,000
Construction contracts awarded 1922	$16,470,000
Repair contracts awarded 1922	2,784,000
	$19,254,000
Of the construction awarded in 1922, $129,000 was cancelled.	
Appropriations for work to be let during 1923:	
Construction	$18,000,000
Repairs	9,988,000
	$27,988,000
A summary of conditions now and a year ago shows the following:	
Work done in 1921	$25,105,000
Work done in 1922	16,329,000
Excess of work done in 1921	$8,776,000
Work left over from 1922	15,492,000
Work left over from 1921	12,633,000
Excess of work left over from 1922	$2,859,000

In explanation of the drop in work done and of the increase in work left over from 1922, Herbert S. Sisson, retiring commissioner of highways, who was present when these figures were announced, pointed out that the season of 1922 was unfavorable for construction work due largely to weather conditions and to the upset transportation conditions brought about by the railroad and coal strikes. He indicated also that probably 50 per cent of the contracts to be awarded this year will not be let before the middle of the construction season and that these cannot be begun before 1924.

Utilization of Blue-Stained Lumber

While it has been established that blue stain in lumber is not an early stage of decay, but merely an indication of the presence in the sapwood of a fungus which does not materially affect the strength of the wood for ordinary commercial purposes, no absolutely effective method of preventing it other than kiln drying has been found. Kiln tests at the Forest Products Laboratory, of the Forest Service, have shown that a temperature of 140 deg. F. for a period of 6 hours is sufficient to kill the blue-stain fungus in the center of test pieces up to 4 in. square. No chemical dip for green lumber has been found which is remedial in periods of continued rain during the warm months. Until a suitable method of prevention is found applicable in cases where kiln drying is not feasible, intelligent utilization of the discolored stock will remain the only means of discounting the damage done by the blue-stain fungus when the methods now available have failed to keep it out. Resurfacing will not help when the fungus has made substantial penetration. Blue stain is freely accepted in rough lumber, lath, scantling, plank and some of the larger sizes of dimensions. More could well be used in the manufacture of sash, doors, millwork and other products when the discoloration is to be painted or otherwise hidden from view.

Referendum Shows Ohio Engineers Against Registration

Engineers Club of Cincinnati Brings Out Sentiment Prior to Vote of Legislature on Proposed Legislation

By Edgar Dow Gilman
Chairman, Registration Committee, Engineers' Club of Cincinnati

THE question of registration for engineers in Ohio has been raised this year by the presentation of a bill to the General Assembly by a group acting under the name "Associated Engineering Organizations of Ohio." This association was formed only a few weeks ago, and for the sole purpose of promoting a registration bill. The bill which has been presented provides for the compulsory registration of engineers employed by or doing work for the state or its subdivisions, and the optional registration of other engineers.

The Engineers' Club of Cincinnati, after carefully considering the whole question of registration, came to the conclusion that such statutory action is wholly unnecessary from the viewpoint of public welfare, and to a considerable extent is duplication of existing and functioning state boards. It was also held that no benefits would accrue to engineers therefrom, and that even if such benefits were to be derived, it is against the best public policy for a state to pass legislation based upon professional benefit. However, the Engineers' Club took the position that if a majority of practising engineers in the state really believed in the bill, the club would take no steps to oppose it.

The sentiment of the engineers of the state was secured by submitting a prepaid ballot to all Ohio members of the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the American Institute of Chemical Engineers. It was, and is, believed that this will represent as true a cross-section of the opinions of practising engineers as could possibly be obtained. Two questions were printed on the post card ballot, the first asking for an opinion on the question of registration as a principle, and the second for an expression on the particular bill now before the legislature. The results are shown in the accompanying tables.

TABLE I—LETTERS SENT OUT

Society	Letters	Replies	Per Cent Replies
A. S. C. E.	444	222	50.0
A. S. M. E.	1,000	348	34.8
A. I. E. E.	530	225	42.4
A. I. Ch. E.	53	21	39.6
	2,027	816	40.2

TABLE IIIa—GEOGRAPHICAL AND SOCIETY RETURNS, PRINCIPLE OF REGISTRATION

	A.S.C.E.			A.S.M.E.			A.I.E.E.			A.I.Ch.E.			Total		
	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote
Akron	7	5	12	5	11	16	2	10	12	1	1	2	15	27	42
Canton	1	..	1	1	4	5	..	5	5	..	..	..	2	9	11
Cincinnati	6	24	31	6	80	86	4	24	29	2	2	4	18	130	150
Cleveland	33	30	67	18	71	90	17	66	85	..	9	9	68	176	251
Columbus	23	6	29	9	18	27	4	9	14	..	1	1	36	33	71
Dayton	11	9	21	4	14	18	..	19	19	..	..	..	15	42	58
Mansfield	..	..	..	..	6	6	..	11	11	..	..	..	..	17	17
Toledo	14	5	19	6	22	30	4	8	12	..	1	1	24	36	62
Youngstown	3	3	6	..	5	5	3	2	5	..	..	..	6	10	16
Scattered	18	17	36	6	56	65	4	28	33	1	3	4	29	104	138
	116	99	222	55	287	348	38	182	225	4	16	21	213	584	816

TABLE II—GENERAL RETURNS

	Favor Principle of Registration		Favor Present Bill		No. Votes
	Yes	No	Yes	No	
1. Straight ballots	168	572	168	572	740
2. Favor Prin.-Oppose bill	29	...	...	29	29
3. Oppose Prin.-Favor bill	...	12	12	...	12
4. Incomplete ballots	16	...	2	4	22
5. No vote	...	...	...	...	13
	213	584	182	605	816

TABLE IIIb—GEOGRAPHICAL AND SOCIETY RETURNS, PRESENT BILL

	A.S.C.E.			A.S.M.E.			A.I.E.E.			A.I.Ch.E.			Total		
	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote
Akron	4	7	12	4	12	16	2	10	12	1	1	2	11	30	42
Canton	..	1	1	1	4	5	..	5	5	..	..	..	1	10	11
Cincinnati	7	24	31	5	81	86	2	26	29	1	3	4	15	134	150
Cleveland	30	33	67	20	70	90	17	65	85	..	9	9	67	177	251
Columbus	20	8	29	9	17	27	2	11	14	..	1	1	31	36	71
Dayton	10	10	21	3	14	18	..	19	19	..	..	..	13	43	58
Mansfield	..	..	..	..	6	6	..	11	11	..	..	..	..	17	17
Toledo	10	7	19	4	24	30	2	8	12	..	1	1	16	40	62
Youngstown	3	3	6	..	5	5	1	3	5	..	..	..	4	11	16
Scattered	15	19	36	4	57	65	4	28	33	1	3	4	24	107	137
	99	112	222	50	290	348	30	186	225	3	17	21	182	605	816

This shows 2.74 to 1 against any registration, and 3.33 to 1 against this particular bill. There are 59 different towns under the item "scattered."

It is interesting to note in Table II the number of ballots which are opposed to the principle of registration, but which favor the registration bill. Most of these come from Cleveland, and were accompanied by explanations that the writers did not believe registration would be of any value to the public or to the engineer, but that it was sure to come, and they were in favor of letting this bill go through because it was drawn so as to have as little effect as possible. The fear was expressed that if this bill was not adopted, some other, having greater objections, might be forced upon the engineers of the state. These ideas are so widespread in the correspondence from Cleveland, that one is led to believe it was systematically used in that city, and to wonder how many of the "yes" votes were caused by this argument. In spite of this, Cleveland goes on record as 176 to 68 against the principle, and 177 to 67 against the particular bill. The closeness of these figures is purely a coincidence, as there were many incomplete and split ballots from this city.

The vote of the electrical and mechanical engineers of the state, as compared with the civil vote brings out some interesting points. The writer does not wish to attempt an analysis of this marked divergence, but believes it may bring out some interesting discussions, and might eventually lead to rational legislation. The civil engineers have a slight majority favoring some registration, but also have a slight majority disapproving the present bill. The electrical and mechanical and chemical engineers are overwhelmingly opposed to any registration whatever.

In view of the ballots shown above, the Engineers' Club of Cincinnati is actively opposing House Bill No. 146, before the House of Representatives, providing for the registration of engineers in Ohio.

Cotton Belt R.R. to Spend $3,750,000

Expenditures totaling $3,750,000 for betterments were approved at a recent meeting of the directors of the Cotton Belt R.R. held in Tyler, Tex. Twelve hundred freight cars will be purchased, their cost to be about $2,500,000.

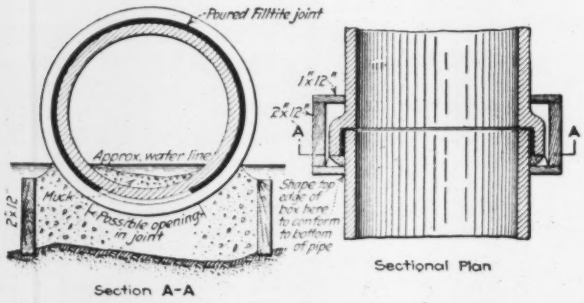
Making Sewer Joints with the Pipe Partly Under Water

Low-Lying Line Paralleling River in Fort Madison, Iowa, Successfully Laid Utilizing Both Plastic and Solid Material

By L. B. Reynolds
Member of Firm of Burns & McDonnell, Kansas City, Mo.

EXPERIENCE in making joints in unusually wet trenches in the recently completed reconstruction and extension of the Fort Madison (Iowa) $400,000 sanitary sewer system brought out the good and bad points of various kinds of joint material. The ingenuity of the contractors and engineers was also under test. Assurance of good joints as well as support for the pipe in insecure ground was finally effected by the use of a bottomless wood box and form within which the joint was made after the sand had been removed.

The new system has three gravity outlets and one pumping outlet, the latter serving a low district along the river. Some water and quicksand were encountered on the high lines but the pumping station and low lines were constructed with considerable difficulty, due to the soil conditions. The pumping station is located on the river front opposite the central portion of the city and the sewage is pumped into the river through 375 ft. of cast-iron pipe. The pumping equipment consists of



BOTTOMLESS BOX FOR MAKING JOINTS
Combined "filtite" and concrete joint made in box filled with concrete after filtite poured to fill possible opening in bottom of joint.

three 150-gal. ejectors and is located under the same roof with the air compressing equipment.

At the lower end the main 24-in. line which parallels the river is 8 ft. below water level in the river and at the upper ends the two branch mains are 1 ft. below water level. Below the surface soil the formation consisted of coarse sand and gravel with pockets of quicksand and some material more nearly a slime than a quicksand. Tight sheeting was necessary on all these lines and at times the pressure became so great from the thoroughly saturated ground that it was necessary to double brace the trench for stretches of 40 to 50 ft. Settlement of sheeting into the bottom of the trench was a common occurrence, accompanied by a general subsidence of the surface near the trench and an upheaval of the bottom of the trench. Increased difficulties were encountered in the form of bubbling springs and sink holes, some of them large enough to engulf a man to the knees should he accidentally step into them. The pressure was quite often so great that it was necessary to hold the pipe down to grade with braces nailed to the sheeting. Sand was continually being washed down upon the pipe work and quite often the sand had to be shoveled back continuously while laying a joint of pipe.

The contractor was protected in this hazardous work by a clause in the specifications allowing him the extra cost of sheeting and bracing and handling water. The specifications also contained a clause allowing the use of special and plastic joints under the usual stipulations for additional work at cost plus a percentage.

Bottomless Box Method—Tests were made before starting the work with several plastic pipe compounds under conditions approximating actual trench work with the pipe partially under water, but it was decided that a good joint could not be assured with any compound poured hot. Too often openings would be found at the bottom of the joint. During the progress of the deep line work continual pumping was necessary, but even then the trench could not be kept entirely clear of water and the pipe had to be laid in water covering one-third to one-half of the pipe. The bottomless box scheme was then devised. The sides were of 1 x 12-in. boards cut down half way on each side to fit the pipe. The ends were of 2 x 10-in. blocks and the length of the box was 12 in. greater than the maximum outside diameter of the pipe. The boxes were placed in the trench so that the bell came inside the box and were then adjusted to bring the pipe to line and grade. The runner was then placed and "filtite" furnished by the Pacific Flush Tank Co., was poured. The form was then cleaned out, filled with concrete and any opening in the bottom of the joint was thus sealed. The contractor favored this method at first, but his pipe-laying gang did not fully co-operate. Difficulties arose. Crooked and narrow places in the trench required sawing off the end of the box which filled with quicksand. The box was held on line and grade with difficulty.

After using the above method for 200 ft. during which time the speed of the entire work had been discouragingly slow due mostly to the inability to complete the excavation fast enough, the contractor and city desired that a new kind of joint be used. A demonstration of the Weston gasket and form, made by L. A. Weston of Adams, Mass., was arranged. The gasket is of galvanized iron, the inner flange being drawn tight on the pipe by means of a small bolt. Though the outer flange is notched to make it pliable it is still sufficiently stiff to form a support for the pipe and to hold it to the flow-line level. The form is of galvanized iron, extends two-thirds of the way around the pipe and is attached firmly by two wires to provide a form for the mortar. Every effort was used to clean out any sand deposited in the form by blowing it out with a steam or air hose passed around inside the form to the bottom. Rich grout was then poured quickly into the form, a laborer forcing it down with some pressure in an attempt to compact the mass, care being taken not to force it through the gasket. A stiffer mortar was used for the upper part of the joint. With 8-in. pipe a packing of clay was used around the mortar when available. Excavated material was thrown back over the joint just laid, but this method was not deemed advisable with large pipe or where there was considerable water. In many places where the foundation was soft, dry-mixed concrete of Class "B" quality was dumped in the bottom of the trench without any form or spading, although an effort was made to keep it from being disturbed. In soft places this dry material was pushed into the bottom to provide a foundation for the

pipe, as much as a yard being used under one joint in some cases. Pumping was continued for at least two hours after the last pipe was laid to prevent undue pressure on the green joint and then the water was allowed to rise over the pipe during the night. The Weston joint was used on the remainder of the 24-in. pipe.

On 18-in. and smaller pipe "filtite" and Weston joints were alternated, the former being poured on the bank where a perfect joint could be obtained. The two sections of pipe were then lowered into the trench and the Weston joint made. This was believed to be the best method of construction, as it was certain that at least every other joint would be watertight and also flexible enough to allow some settlement without breaking the pipe or the joints.

Inspection—After the low lines were completed an interior inspection of the 24 and 18-in. pipe was made, which revealed the results of the pipelaying methods. The only failure found with the combined form of joint (using filtite with the concrete box beneath) was when the filtite did not reach down to the concrete, thus leaving an opening. In these cases the box had been cut off on one side due to a crooked trench, thus bringing the pipe so close to the sheeting that there was no chance of inspection before backfilling.

Actual cost records showed that no more labor was required with the filtite joints than with the Weston joints. If properly laid the percentage of failures would be small and the danger of rupture by settlement would be slight. However, the possibility of filtite running through the oakum somewhere seems to be against its use for pipe too small to allow an interior inspection.

The joint failures with the Weston gasket and form occurred in a number of different ways. Where the joint was used in water there was almost always a slight current flowing through the slit openings of the form or through openings where the form did not fit tightly around the spigot or bell. In a fine sand formation this continuous flow of water tended to carry sand into the form in the interval between the blowing out of the joint with steam and the pouring of the grout. When the water in the trench was half-way up on the pipe, or more, this deposit of sand often took place without being noted. The accumulation of sand in the bottom of the form, due to its not being completely blown out or to its being subsequently washed in or to a settling out of the sand from the joint mortar, was sometimes washed out later leaving an opening in the joint which was not discovered until the interior inspection was made.

Grout Difficulties—Sometimes at the time of pouring the joint, or subsequently, some of the grout found its way into the interior of the pipe. Oakum was tried, but without great success, in connection with the Weston gasket to prevent this entry of grout. When the grout ran directly into the pipe at the time of pouring, the loss was usually noticed by the amount of grout required or by a subsidence in the form. Sometimes, however, the grout would settle after the stiffer top mortar was partly set and the subsidence of the grout would not be noticed, thus leaving an opening on the side. In some cases the pressure of bubbling springs may have set up currents of water which gradually carried away the grouting from the bottom of the form until an opening was produced through the joint. An inspection of all uncovered joints was made frequently to detect such defects. Whenever the grout ran into the interior of the pipe there was the probability of a considerable deposit of mortar on the inside which later had to be chipped out or dragged out in the case of pipe too small for interior work.

When the interior inspection of the larger pipe was made accumulations of mortar and filtite were found

DEEP MAIN SEWER LINE EXCAVATED WITH TRENCHING MACHINE AND BACKFILLED WITH CLAM SHELL

in several places and removed. All openings greater than ¾ in. wide were filled with mortar or with strips of lead molded to fit the opening if the leaks did not allow mortar to be placed. On the smaller lines only such leaks were repaired as could be seen from manholes or Y's by the use of mirrors.

Leakage—The total leakage of more than 200 gal. per minute before any repair work was done was reduced to 87 gal. after the leakage elimination work was completed. Of the 4.3 miles of pipe in the pumping system sections totaling 3.4 miles were laid in wet trenches. The leakage per mile of main per day on the pumping system is 29,700 gal., which was considered to be the minimum obtainable at reasonable cost under the existing conditions. The total cost of the low lines exclusive of the ejector station was $128,000, of which $34,500 was allowed above the bid prices, to cover the cost of handling water and the extra cost of sheeting, bracing and special joints made necessary by the water and quicksand.

The contractor was the National Construction Co., of Davenport, Iowa. The supervising engineer in charge of the work was M. H. Walser, of Burns & McDonnell Engineering Co.

Statistics of Some Leading British Railways

Railway	Total Expenditure on Capital Account, £	Miles in Work	Total Net Income, £	Locomotives	Passenger Coaches	Freight Cars
Gt. Eastern	54,144,330	1,133	2,161,473	1,284	5,748	27,150
Gt. Central	57,189,552	757	2,226,910	1,339	2,698	34,433
Gt. Northern	54,592,525	863	2,439,237	1,359	3,399	38,915
Gt. Western	114,646,195	3,008	5,873,223	3,084	8,604	76,967
Lancs. & Yorks	64,926,293	591	2,618,517	1,573	4,414	34,431
Lon. Northwestern	124,351,013	1,969	6,281,898	3,051	9,371	75,739
Midland	130,064,729	1,533	6,275,566	3,013	6,742	119,199
North Eastern	86,374,564	1,728	4,255,104	1,989	4,757	116,655

Pumping Assists Reclamation of Alkali Lands

Experiments on Land Spoiled by Irrigation—Drainage Accelerated by Pumping Is Better Than Gravity Flow

TO RESTORE LAND to a cultivable condition after it has been rendered alkaline by excessive irrigation or seepage from irrigated areas a combination of drainage to lower the water table and flooding to wash out the salts has been employed in several cases, but this process can be accelerated by pumping. This is the main point of a paper presented before the National Drainage Congress by W. W. Weir, assistant professor of soil technology at the University of California. Further, he suggests that the cost of pumping may be reduced by using the water elsewhere for irrigation. He points out, however, that the first consideration should be to prevent the waterlogging of land by excess irrigation or by seepage water, since it is almost impossible to restore the land to its original productivity. A brief abstract of Mr. Weir's paper, dealing with developments in this land reclamation problem in California is given below.

Some forty years ago Dr. Hilgard began studying soil alkali in relation to irrigation and he predicted the increase in drainage that would result from the continued use of excessive amounts of water. He recommended draining the land to reduce the water table and flooding the land after drainage to leach out the alkali and redistribute it throughout the soil. He also advocated the use of gypsum on black alkali land in order to change it over to the more leachable sulphate form.

Flooding land after drainage, in order to wash the surface accumulations of alkali back into the soil and out through the drains, is being practiced today about as advocated forty years ago. But the lowering of the water table by drainage is not sufficient to bring a highly alkaline tract back into productiveness. It is necessary next to remove the alkali which has already accumulated. The process is to prepare the land so that it can be flooded to a depth of six to twelve inches and kept under water for a period. The depth of water and the period of submergence are dependent upon the soil and the amount of alkali.

Engineers too often think they are through with drainage when they have accepted the drains from the contractor, but the work is not finished until the land is brought back to productiveness. Engineering advice and assistance are just as necessary in this last step as in the design of the drainage system.

A drainage district in California that was fine alfalfa, vineyard and truck land became waterlogged and alkaline, and the entire area was used as salt grass pasture. A tile drainage system was installed at a cost of about $75 per acre, and the water table was lowered to about 8 ft. At this point the officials of the district thought that they had finished with the services of their engineer, and he was discharged. Three years afterward the land was not producing as much as it did before it was drained, as the salt grass had died because of the removal of the moisture. The trouble was that the land now had to be irrigated, reclaimed from alkali and put back into alfalfa. This was an engineering job.

In regard to the black alkali or sodium carbonate problem, Dr. Hilgard probably was partly right when he advocated the use of gypsum on black alkali land. But, he failed to appreciate the importance of black alkali, or the practical difficulties in handling it. It is substantially true that there never has been a black alkali area successfully reclaimed. There have been numerous attempts, but for one reason or another they have not been successful.

Experience with Black Alkali—In 1912 the University of California took a bad piece of black alkali land, 160 acres, in which it was thought possible to eliminate all of the reasons that had been assigned for failures in other sections, such as insufficient depth of drainage, feeble attempts at flooding, lack of interest, etc. It was drained with tile, flooded, and everything else done that was thought necessary. Furthermore, we had almost complete control of the operations. But the tract is not yet producing as good crops as it did before it became alkaline. After five or six years the University started more complete investigations, with the result that we discovered that we were tackling something that had never been done, namely, the complete reclamation of black alkali land. I do not say it cannot be done, but so far as we have been able to learn, it never has been done.

We then took a small area of about seven acres, divided into nine plots, in the worst land that had been tile drained, and proceeded to treat it intensively. The tract was carefully leveled, plowed and prepared as a seed bed. The soil was sampled and tested for alkali. Gypsum was then applied at the rate of three tons and six tons per acre to three plots each, the other three plots remaining as checks. The nine plots were then flooded to a depth of about one foot. When the water had disappeared, which required a couple of weeks, the plots were cultivated and flooded again. This was repeated a third time. Barley was then planted, and the yield plotted and compared with the yield that had been grown and plotted previous to the treatment. This process has been repeated with the addition of more gypsum to three of the plots, and sulphur added to additional plots. The soil sampling, crop yields and all other data have now been obtained for three years.

Briefly, we have very greatly improved all of the plots; those to which only water was added, as well as those to which gypsum was added. The balance, however, is in favor of the gypsum when only yields of barley are considered. But when cost is considered, the whole thing has not been a success. Even those plots upon which the most gypsum was applied are not yet 100 per cent perfect. The result indicates that we do not know how to treat black alkali land commercially in order to reclaim it.

This work may seem beyond the realm of the engineer, but in fact it is an engineering problem just as much as the building of a bridge. The engineer might as well say: "I've built a bridge, what do I care whether it is fit to travel over or not." The engineer is vitally concerned as to whether a piece of land upon which he has placed tile drains will grow anything. We are certain of this one thing regarding alkali; that it is necessary, as the first step, to lower the water table or to keep it beyond capillary reach of the surface.

Pumping appears to me to be a logical and entirely feasible method of reducing the water table over many areas which have poor drainage as a result of irrigation. The essential points are to find a well or series of wells capable of delivering a good supply, put on pumps of sufficient size to take it out, and to find a continuous use for the water. The advantages are: (1) Possibility of lowering the water table below any depth feasible by a gravity system, thus assuring the success of alkali prevention; (2) it makes more available the water developed than would be possible by a gravity system where it would be necessary in most cases to pump it on to higher lands; (3) the first cost is considerably less than gravity drainage; (4) it is applicable where gravity outlets are unavailable. The disadvantages are: (1) The dependence of pumps on human beings for their continued operation; (2) the operating costs.

In closing, let me repeat that the only true remedy for alkali and waterlogging conditions is to prevent its occurring. This brings us again to the pumping idea. Every sound irrigation development in the future will be based on obtaining at least a portion of its water from underground sources. New developments that have no present prospect of gravity water can succeed if the older waterlogged areas will permit pumping. And the older waterlogged areas are doomed to failure unless they do pump from their ever-increasing underground supply. Thus irrigation and drainage will work hand in hand.

Lining a Power Ditch While in Service

Precast Semi-Circular Frames Made of Gunite Dropped Into Flowing Stream and Joined When Sections Are Laid Dry—Concrete Materials Floated to Place in Welded Steel Tubs

IN THE development of the El Dorado hydro-electric project of the Western States Gas and Electric Co., in the Sierra mountains near Placerville, Calif., an old unlined power ditch is being lined with concrete by a novel application of precast sections built up by the cement gun and sunk into place in the flowing ditch.

This old ditch, in the American River canyon, dates back to gold rush days and now is subject to claims of the city of Placerville for its water supply. The water rights were purchased by the power company, still subject to the city's claim, and the ditch made a part of the new power plant which will develop 26,000 hp. from a series of reservoirs. Incident to the improvement it was necessary to enlarge the capacity of the ditch, at the same time not shutting off its flow for any length of time. The method here described was adopted as an alternative to bypassing, which it was felt would be unduly expensive.

Determination was made to take advantage of the high strength of gunite and the ease of placing and of

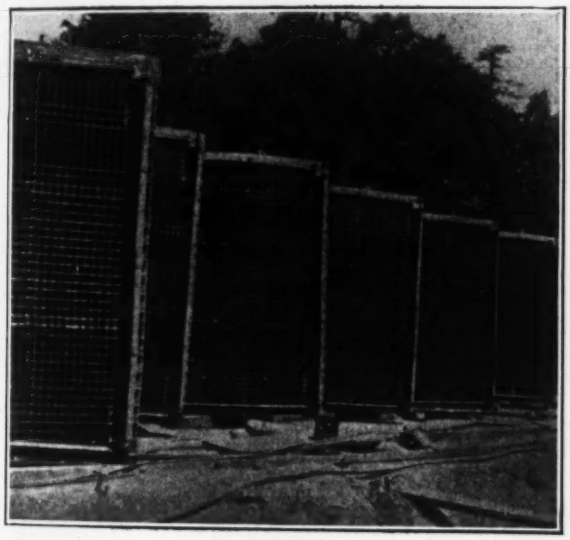


FIG. 1—FORMS READY FOR GUNITE

These frames are set up alongside the ditch and are then covered on each side with gunite and then lifted into place as shown in Fig. 3.

handling within a few hours after it is shot. Heavy steel forms fully braced across the top, as will be seen in Fig. 1, were built and fitted along the edges with a slotted shoulder, so arranged with thumb screws at each slot that each strand of the 2x2 in. reinforcing mesh will be firmly held in place against the form. These are stood vertically on the berme of the ditch as shown in Fig. 1 and the gunite shot on to a thickness of two inches. Different methods, such as covering the forms with paper, or greasing, were tried to obtain a coating for the steel form that would insure prompt release of the gunite slab, but it was finally decided to adopt a heavy coat of shellac after the forms are cleaned and prior to placing the reinforcing mesh.

Fig. 1 shows a number of forms in place for guniting. Fig. 2 shows a form being lowered into the ditch. This is done by a traveling derrick which moves on rollers along the outer berme. To insure against overturning, this derrick is designed with an outrigger which spans the ditch, and is weighted down on the opposite berme. In placing the form is held firmly in its definite position

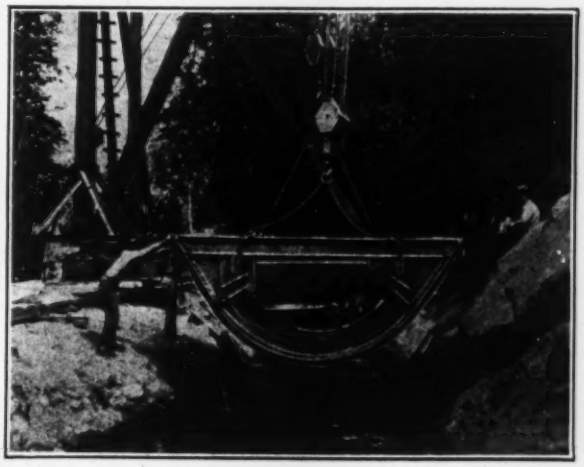


FIG. 2—LOWERING A GUNITE SECTION INTO PLACE

of line and grade by the derrick slings while backfill is being placed behind the slab. After the backfill is completed the wires are released at the thumb screws and the form is easily lifted out of the completed slab.

In addition to the derrick described above, which has its boom pointing downstream, there is, in advance of this traveler, and two or three hundred feet further downstream, a similar traveler with the derrick boom pointing upstream. The function of this traveler is to handle the forms which are floated downstream from the setting derrick on a small barge as shown in Fig. 4 and also to handle the sand and cement for the cement-gun equipment immediately adjacent. The forms after being lifted from the scow are stood on end, cleaned and shellaced and are again ready for the reinforcing mesh and gunite covering, thus insuring a continuity of operation with the same set of forms.

Each section is spaced by a spacer block at a fixed distance from the previously placed section, and after several hundred feet of lining have been completed, the water is shut off for a short time and the spaces filled with gunite shot directly in place. Inasmuch as the

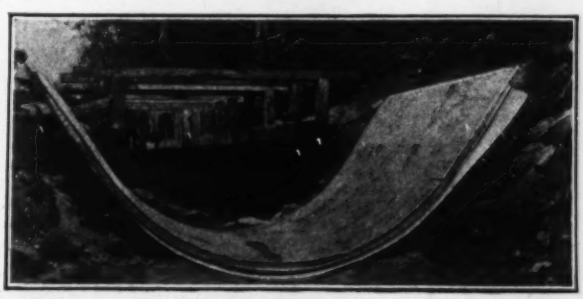


FIG. 3—A COMPLETED LINING SECTION IN DRY DITCH

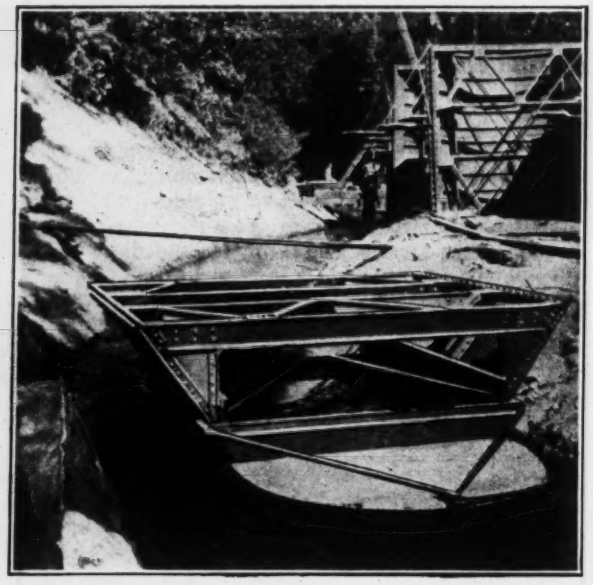


FIG. 4—CARRYING A STEEL FORM BACK TO BE GUNITED

wire mesh extends beyond the end of each section, to provide a reinforcement connection for possible future enlargement of the section, ample reinforcement is provided for these joints.

On account of the roughness of the country, transportation by road is impossible so the water in the ditch itself is made use of to carry the material. At the upstream end of the ditch a granite quarry of superior quality has been opened and a crushing plant installed for making sand. This sand is then loaded into steel tubs (Fig. 5) which are floated to the point of working. The specifications required that the tubs should be built of ⅛-in. black annealed steel sheet, 6½ ft. in diameter, with sides 3 ft. high, sloping inward to a dished bottom 10 in. deep; that the tubs float 8 in. out of water when carrying a 3,000-lb. load, and that they be leak-proof and free from projections on the outside. Two hundred such tubs were ordered.

After the materials are dumped into the bins the tubs are placed in the stream, and floated to a fixed derrick

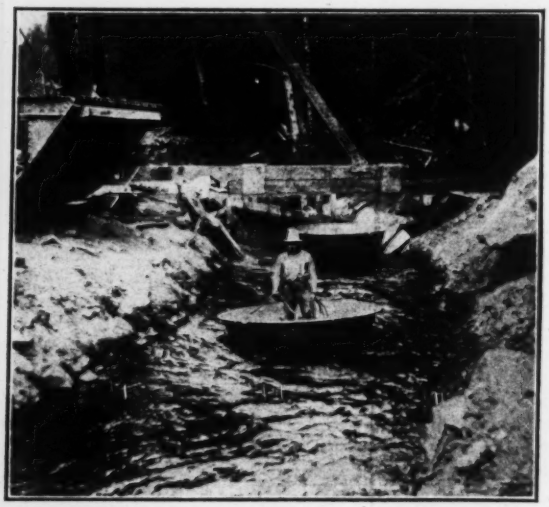


FIG. 5—TUB CARRIES MATERIAL TO CEMENT GUN

located at one of the two or three places where the ditch is crossed by the main highway. They are lifted out by this derrick, nested and carried on auto trucks back to the quarry. Cement which is brought by train to a station near the lower end of the ditch is handled by trucks to a convenient road crossing, and handled in the tubs in a similar manner.

Four cement-gun equipments with accompanying derricks have been provided. Each equipment consists of one cement-gun with a 13x8 in. horizontal type double acting portable compressor. One of these compressors is driven by a gasoline motor, but the other three, as

FIG. 6—COMPLETED DITCH WITH CONCRETE LINING

well as the derrick hoists, are driven by electricity supplied from a small unit at the dam site.

H. M. Byllesby & Co. are the engineers on the work, which is in direct charge of H. H. Fisher as general superintendent and W. B. Rittenhouse as chief field and designing engineer.

Effect of Gatun Lake on Local Rainfall

It has been suggested that the creation of an inland body of water as large as Gatun Lake (165 square miles) might possibly result in a slight increase in precipitation, especially during the dry season, at stations on the leeward side of the lake. A study in 1918 of the records then available, to determine whether there had been such a result, was inconclusive. It appeared then that the creation of Gatun Lake had had no appreciable effect on Isthmian rainfall, or that the effect had been so slight that records extending over a much longer period would be required to disclose even slight local increases of precipitation, resulting from the increase in atmospheric humidity due to evaporation from the lake surface. A further study of the records available to the close of the year 1921 also fails to disclose an increase in rainfall. In fact, the average annual precipitation at seven stations from Gamboa to Balboa during the years from 1913 to 1921 was less in every instance than the annual average at the same stations during the years of record prior to 1913. Even when the excessive rainfall of 1909 and 1910 is omitted from the calculation the result is the same except at one station. However, it is generally conceded that rainfall increases or decreases over long periods in indefinite cycles, and it is possible that the slight effect of the lake on precipitation was obscured by factors operating to make 1919 and 1920 years of minimum rainfall.—*Panama Canal Record.*

Stream-Flow Measurements Under Tidal Influence

Methods Applied on Sacramento River Provide for Reversal of Current and Seasonal Variations in Ocean Level

By E. A. Bailey
Flood Control Engineer
Department of Engineering, State of California

During the low water season of 1920 it was desired to determine the total flow of fresh water into the Delta of the Sacramento and San Joaquin Rivers upon which salt water from San Francisco Bay was encroaching. This necessitated measuring the discharge and establishing rating curves for these streams within the tidal influence in order to eliminate the irrigation diversions and tributaries of the valleys above. The Sacramento River was measured at Sacramento City, 60 miles above the mouth of the river, where the mean daily elevation of the water surface averaged only about a foot above mean sea level for a month, the minimum being 0.63 on July 22, with an extreme low tide that day reaching 0.5 below mean sea level and a minimum mean discharge of 440 sec.-ft. There was a tidal range of from 2 to 3 ft., with a reverse current actually carrying the water upstream past the gaging station from five to nine hours each day. To complicate the matter still further it was found that the mean tide level of the ocean varies from day to day, with a maximum range during the season of about three-fourths of a foot.

To meet these varying conditions, a system was developed whereby the mean discharge was determined with the use of special equipment during a complete tidal-cycle period about once every ten days or two weeks during the season, from which a rating curve was established after applying a correction for the variation of mean tide level, from which the mean daily discharge was determined by application of this curve to the corrected mean daily gage heights. The results obtained are believed to be within the usual limits of accuracy.

Tidal Cycle Measurements—The period of time between two successive, corresponding tides, called a "tidal cycle," is approximately 24 hr. 50 min. The effect of the tide was to produce a heavy run out during ebb tide and a slackening of the flow, and even an upstream current, during flood tide. It was necessary, therefore, to obtain practically continuous discharge measurements over the entire tidal-cycle period.

At the first of the season the velocity of the water at a fixed point in the stream, having as near as possible the mean velocity of the entire section, as determined by a complete metering of the section, was recorded by anchoring a mast in the stream with a projecting arm from which was suspended a cable passing through a pulley attached to a current meter. (See Fig. 1.) The other end of the cable was fastened to a float which was free to rise and fall with the tide, the mast acting as a guide to hold the float in a fixed position. By this means the current meter, being set at 0.6 depth of the stream at mean tide, was automatically kept very close to that depth at all times, as the tide rose and fell. The revolutions of the current meter were recorded on a chronograph stationed on the bank of the stream, and connected with the meter by an electric cable.

In this way a continuous measurement of the velocity near the mean point was obtained for the entire tidal cycle period. In addition to this, several discharge measurements with observations taken at intervals of 10 or 20 ft. across the stream were made from which the mean velocity of the stream was determined, and a curve plotted through these mean velocity points and parallel with, or similar to, the continuously measured velocity curve, where it did not coincide with the mean velocity points.

A continuous discharge curve was then constructed from the mean velocity curve and the areas of cross-section at short intervals of time, and the mean of this discharge curve obtained by a planimeter for a tidal-cycle period. (Fig. 2.) The period was so chosen that the elevation of the water surface was as nearly as possible the same at the beginning and end of the period, so as to eliminate any effect of difference in storage in the channel above the gaging station.

As the season advanced and the direction of the flow began to reverse (the maximum upstream flow at Sacramento amounting to 9 hr. 20 min. during a tidal-

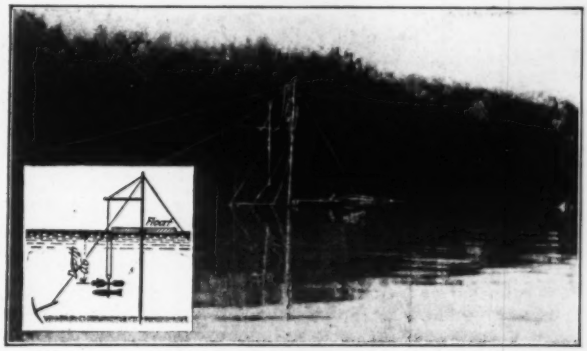


FIG. 1—ANCHORED CURRENT METER WITH FLOAT AND PULLEY TO KEEP METER AT 0.6 DEPTH

cycle period), too much variation in the location of the point of mean velocity of the stream was found so that the method of recording the velocity at one point continuously was abandoned and the following method pursued: One or two careful measurements of discharge were made with velocity measurements taken at close intervals, and at the time of the tide when the velocity was changing the least. From these measurements a curve was plotted showing the velocity across the stream, and certain points in the cross-section of the stream were then chosen for the regular velocity observations, as few in number as possible and yet giving a true mean velocity for each section. Velocity measurements were then taken at these chosen points in each section once each hour during the tidal-cycle period, the object being to obtain these measurements across the entire section as quickly as possible before the velocity should change materially.

Careful soundings were taken at close intervals across the stream at high and low tides, the object being to obtain these soundings during a time when there was little or no change in the elevation of the water surface. The various soundings were plotted and their mean used, together with the mean elevation of the water surface during the periods of velocity measurements, in determining the areas for computing the discharge for such hourly measurements. A temporary

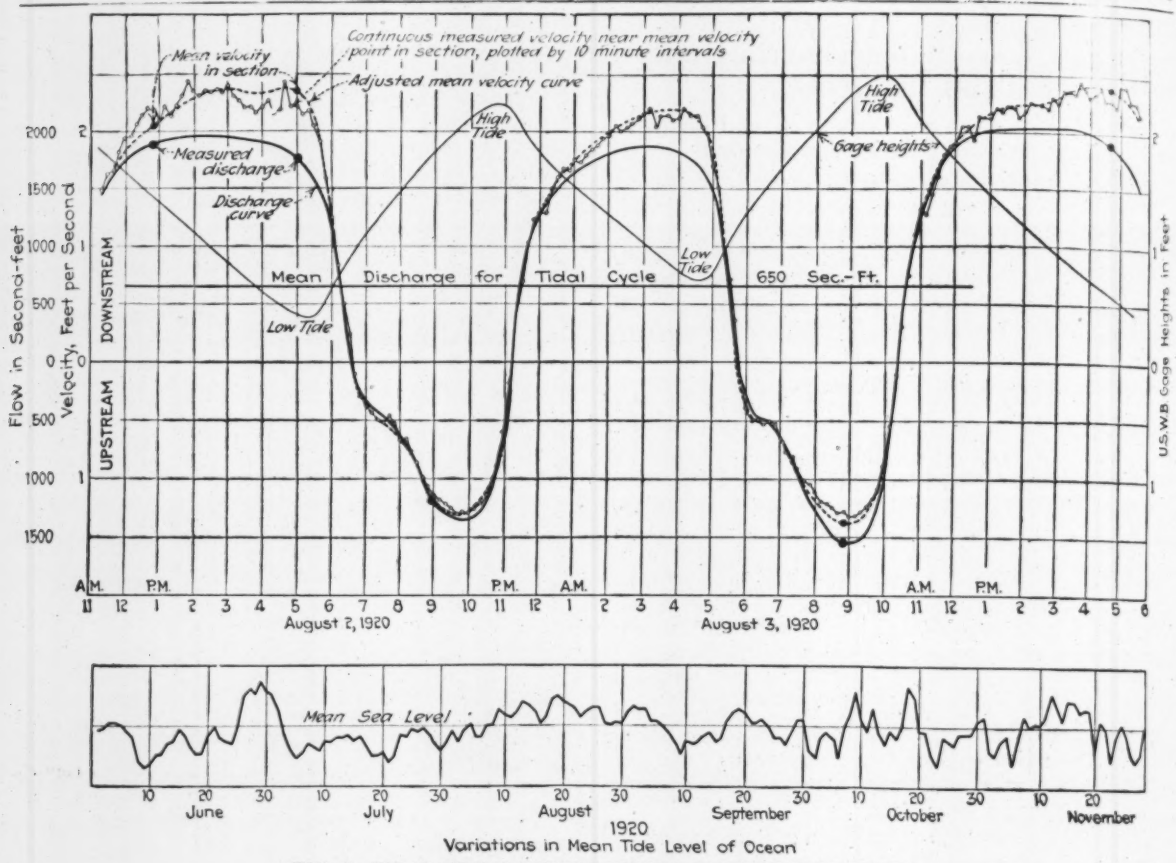


FIG. 2—TIDAL-CYCLE MEASUREMENT, SACRAMENTO RIVER

gage set at the gaging station was read as often as necessary to show a complete curve of the tidal variation. A discharge curve was then drawn through these hourly discharge measurements and the mean discharge determined as before. Velocity measurements were omitted near the time of reversal, which was determined as nearly as possible by observation of a long float, reaching nearly to the bed of the stream, and held by a long cord, from drifting too far from the observation boat.

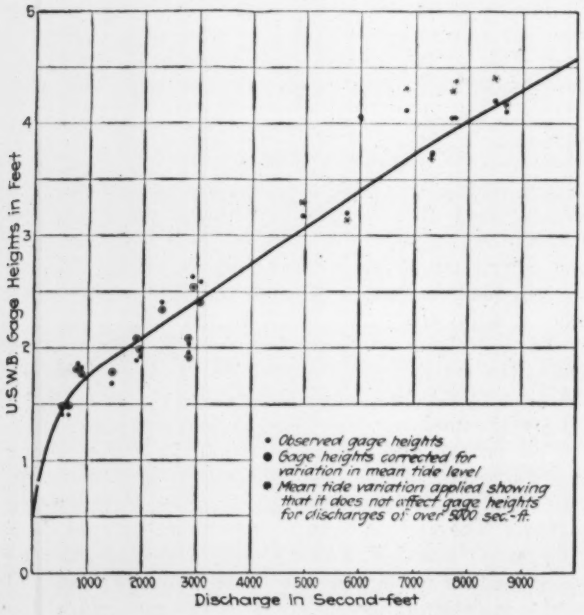

U.S.W.B. Gage Heights in Feet
Discharge in Second-feet
• Observed gage heights
• Gage heights corrected for variation in mean tide level
• Mean tide variation applied showing that it does not affect gage heights for discharges of over 5000 sec.-ft.

FIG. 3—RATING CURVE OF SACRAMENTO RIVER
Based on measurements at Sacramento in 1920

Variation in Mean Tide Level—During the season of 1920 the elevation of mean tide varied from 0.38 ft. above to 0.35 ft. below mean sea level. During the extreme low water period, when the elevation of the water surface at the gaging stations was but little above mean sea level, this variation in the level of the ocean was transmitted with the tidal waves up the streams and affected the gage readings at these stations.

In order to construct a rating curve from the discharge measurements for such stations it was necessary to determine this variation in mean tide level of the ocean and apply a corresponding correction to the observed gage heights. The mean tide variation was obtained from the records of the tide gage at Fort Point near the entrance of San Francisco Bay, which is maintained by the United States Coast and Geodetic Survey. This gage is well constructed, well housed, and is visited at least every two days by the attendant. It is the only gage either on the bay or in the valley, which was to be found, from which a continuous and correct record could be obtained.

Rating Curves—The discharge measurements were plotted with both the observed gage heights and the adjusted gage heights; the adjusted heights being obtained by applying the variation in mean tide level of the ocean so as to reduce the gage heights to what they would have been had there been no variation from mean sea level. The result (Fig. 3) showed very strikingly the effect of this variation upon the gage heights below certain stages.

On the Sacramento River rating curve, the application of the mean tide correction brought all except one of the plotted discharge measurements closer to a mean curve, for mean discharges of less than 3,050 sec.-ft., while for discharges over 4,950 sec.-ft. the application of this correction moved all points except one farther from the mean curve. It happens that no discharge measurements were taken between these limits. In applying the rating curve to the daily mean gage heights to obtain the daily mean discharge, the mean tide correction was tapered off, from the use of the full correction up to 4,000 sec.-ft. discharge to zero correction for 5,000 sec.-ft. On the San Joaquin River rating curve the mean tide variation was shown to be effective up to a discharge of 1,000 sec.-ft. and was tapered to zero correction at a discharge of 1,500 sec.-ft. The difference in the limiting discharge in the two streams is due to the difference in the average cross-section of the two channels below the gaging stations, that of the Sacramento being about 6,000 sq.ft. and the San Joaquin about 2,000 sq.ft. These rating curves could only be used for the low stages after ob-

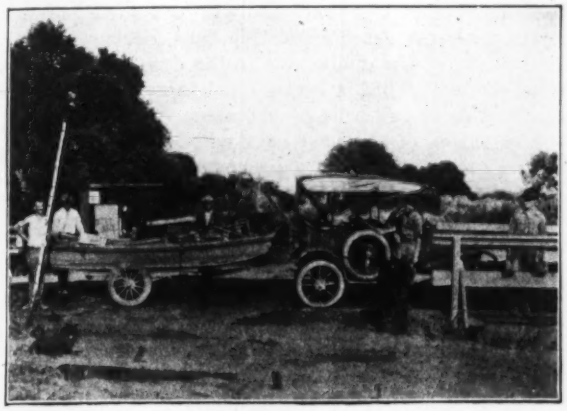


FIG. 4—PORTABLE EQUIPMENT FOR GAGING
Special skiff and gaging party moved from station to station by Ford car and trailer.

taining the mean tidal variation correction from the Fort Point Gage.

Equipment and Staff—A 16-ft. double transom skiff, especially constructed for the purpose, was carried on a trailer behind a Ford, from one gaging station to another for use in taking the measurements. The skiff was held in position by a ¼-in. wire cable stretched across the stream. The work was done by a four-man party—8-hr. shifts of two men each. A fifth man as chief of party, to see that gage heights are obtained with sufficient accuracy.

A Stevens water-stage register, type E, with an elevation scale of 1 in. equals 0.2 ft., was used for recording the water level. The greatest emphasis had to be placed upon the instructions to the field party to obtain sufficiently accurate observations of the gage heights, and to accurately connect their observations at the Gaging Station with readings on the U. S. Weather Bureau gage, to which the rating curve was referred. The gage height observations should be accurate within 0.01 ft. This accuracy may be obtained, even in choppy weather, by the use of a glass tube, corked at both ends, with a small hole through each cork, and a wooden ball colored with red ink floating on the water surface within the glass tube, the tube being held in position upon the scale of a staff gage by screw-eyes.

Fixed Value and Variable Return as a Rate Base

Annual Revision of Fair Rate of Return Simpler and Less Wasteful than Periodical Revaluation of Properties

By Leo Hudson
of Hudson & Myron, Engineers, Pittsburgh, Pa.

JUST at this time of greatly fluctuating prices, naturally the basis upon which inventories are priced for the purpose of evaluating public utility properties is of great interest. Generally speaking, there are three bases used, and in some cases a combination of the three. These are: (1) the actual known prudent investment, or, in case of this investment not being actually known, the reproduction cost as of the dates of actual construction; (2) the reproduction cost as of the time at which the evaluation is being made; (3) the reproduction cost in terms of some average of prices.

There are advocates of the original prudent investment, as indicated by Edward Flad's paper in *Engineering News-Record*, of Nov. 2, 1922, p. 736. These advocates can produce, and do produce, copious court decisions to substantiate their position. The advocates of the reproduction cost at the time of the appraisal also produce copious and authoritative court decisions, the leading decision perhaps being that of Justice Clark in the case of City of Houston vs. Southwestern Bell Telephone Co. as decided May 29, 1922, and as reported in the Supreme Court Recorder, Advance Sheets, issued under date of July 2, 1922. The advocates supporting the reproduction cost in terms of a fair average of prices offer, in support, a stability of procedure not experienced in taking either the actual cost nor the reproduction cost as of any certain date, but an average set of figures which will, if extended into the future, most probably represent a plateau of prices over the time for which the rates are being made. These advocates also offer copious court decisions: the procedure under the Galveston Electric Co. vs. City of Galveston, et al., as decided by Justice Brandies, April 10, 1922, and as reported in the Supreme Court Recorder, Advance Sheets, issued May 15, 1922. Also, these advocates offer the exact specification of the act in Pennsylvania and perhaps in other states. Then, there are advocates who would combine these different elements according to the conditions surrounding each specific case, for the purpose of arriving at a figure to represent "fair value" for rate-making purposes.

Variable Valuations and Fixed Rate—All of these advocates seem to hold to bases which will produce variable valuations and the most of them consider the valuations in terms of a fixed rate of return. Mr. Flad, however, does offer to give consideration to the variation of the rate of return in so far as it may be influenced by variation in the interest rate.

It seems to the writer that there is some danger of inconsistency in the method selected from time to time, in that the advocate of the high-priced periods will "find the shoe on the other foot" in case of a sharp future drop in prices, and the advocate of the high-priced peak of 1920 perhaps would not have used the same argument in the year 1914. In like manner, an investor actually putting his money into the property during the time of high prices would perhaps have his

investment embarrassed at the time of low prices in case a reproduction cost method of procedure were followed.

Fixed Valuation and Variable Rate—The author feels that the assuming of these different processes has taken place not as a result of the dictates of the fundamental common law, nor of the exact language of the statutory law. The varying court decisions indicate clearly that we stand, even today, on a foundation of shifting sand, in so far as evaluation is concerned. It is for this reason, with others, that it appears that many of the difficulties encountered in the evaluation of public utilities properties and the fixing and changing of rates could be simplified greatly and at the same time in terms of greater justice to both the investor and the public, if more attention would be placed upon fixing the "fair valuation" of the property as a constant and upon taking up the variation in the rate of return. When we speak of valuation as a constant, we, of course, mean that this should change naturally as the changes actually take place, in that retirements, depletions and depreciation should be written off and additions to capital written on, as these things actually take place. These deductions and additions, however, to be made in terms of a fixed original cost, which fixed cost would not be subject to change at the end of each period stipulated by the Act creating the Public Service Commission of each state. In order to arrive at this fixed base, the author believes that, unquestionably, the most logical basis is that of the actual prudent investment.

The varying purchasing power of a dollar can be quite accurately secured in terms of general commodities, and the federal government is at this time issuing from time to time a general commodity index figure which shows what the varying purchasing power of a dollar is.

Not Inconsistent With Court Decisions—The author believes that this solution is not inconsistent with the court decisions clearly in favor of the actual investment as the basis of valuation. We also feel that this suggestion is not inconsistent with the court decisions which say that the cost as of the time of the valuation is the proper basis, and we believe that the argument in favor of average prices can be automatically worked out through consideration of the variable rate of return. A determination could readily be made on the books of the company at the end of each year under this specification and the rates for the preceding year could be readily adjusted by the giving of a rebate, or the placing of a surcharge which would accomplish the purpose. The entire fighting ground of such a proposition would be in the determination of what was the purchasing value of a dollar as of that date, or what it had been over the year just passed. The difficulties here do not seem to the author to be anywhere comparable to the difficulties experienced by the revaluation of a property. We believe also that there is nothing in this proposition inconsistent with the statutory laws of the several states creating the Public Service Commissions, and that this method can be readily interpreted to be within the authority of the several commissions.

Method Just to All Parties—The present tendency to make valuation a variable and the rate of return a constant can be strongly supported through the argument that the valuation of anything does, as a matter of fact, change from time to time and that the fixed rate of return is more favorable to the parties holding the securities of the corporation. We believe that the valuation of a thing does change from time to time, and it is to produce the ever-changing value of the dollars invested in a thing that we are trying to solve in terms of a variable rate of return and not in terms of the variable number of money units. As to the security holders, the bondholders receive a constant rate of return on their securities and it is the stockholder who benefits or who suffers by the fluctuation in the basis of valuation. This method might possibly produce a return on certain portions of the investment below the rate of interest which the bonds call for for certain years, but, on the other hand, it would create a higher rate of return during other years, and this method would call upon the stockholder to make the bonds absolutely secure, as he does under the present methods.

We believe that the application of this method would be beneficial not only to the investors, but also to the public, in that it would discontinue to a great extent at least the constant state of warfare which now exists between the public and their utilities. Valuations which were established two years ago will have to be reviewed again within a year or so, this time, perhaps, on the application of the public, due to the drop in the cost of commodities. This is because the valuation two years ago was fixed in terms of the same rate of return as the valuation of the next year will be fixed.

The present methods are expensive to the corporation, are expensive to the public, and are expensive to the state, all of which means that it is three-fold expensive to the people, because it is the people who will pay the entire bill in the end. It burdens up work to be done by Public Service Commissions, which takes their valuable time from work of a more valuable nature. The present method is actually producing a cost of government which will ultimately result in the government supporting the people instead of the people supporting the government. The solution of one case under the present condition will necessarily call for a reconsideration and another solution within a short period to follow, the corporations taking the initiative in the years of high prices, and the people taking the initiative in the years of low prices. Ultimately, the bridge will become so heavy that it will fail of its own weight.

Cost of Submerged Outlet Sewers

The accompanying table of the cost of submerged outlet sewers is taken from a brief report of the Committee of the Boston Society of Civil Engineers on Methods of Design and Construction and Results of Operation of Submerged Pipe Lines for Outfall Sewers, printed in the Journal of the society for January. The report states that "under extreme circumstances, the costs were in a few instances 100 per cent in excess of and 50 per cent less than those" given in the table; also that the cost figures were for average pre-war conditions. The committee was composed of Hiram A. Miller, chairman, Edgar S. Dorr and George A. Sampson.

COST OF SUBMERGED OUTFALL SEWERS

Size In.	Price per Foot Including Outlet	Size In.	Price per Foot Including Outlet
8	$5.00	48	20.00
12	6.25	60	26.00
16	7.50	72	32.50
24	10.25	84	39.50
36	14.75		

Automobile Control, City Planning and Traffic Regulation

Limits of Car Operation in Relation to Speed and Road Capacity Demand Better Street Plans and Traffic Rules

By Herbert S. Swan
City Planner, New York City
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HOW fast can a motor vehicle go without endangering the safety of its slower neighbor? How long a time does it take a machine traveling at different rates of speed to stop? What relationship does the speed of a car bear to its stopping distance on a dry road? On a wet road? When going downhill? Going uphill? How much ground does a car cover in a second if it is traveling 20 miles an hour? Forty miles an hour? Sixty miles an hour? How fast can a car run and yet be stopped within a second? What effect has a load upon the stopping time and distance of a car? These appear to be elementary problems in the operation of an automobile. They confront every driver every minute of the day and yet they are questions concerning which not even the average manufacturer of automobiles has precise and accurate data.

Braking—The time required to stop cars going at different speeds is in exact proportion to the speed of the car. The rate of deceleration which can ordinarily be attained is in the neighborhood of 8 ft. per sec. per sec.; that is, the velocity can be reduced 8 ft. per sec. or at the rate of 5.4 miles per hour each second until

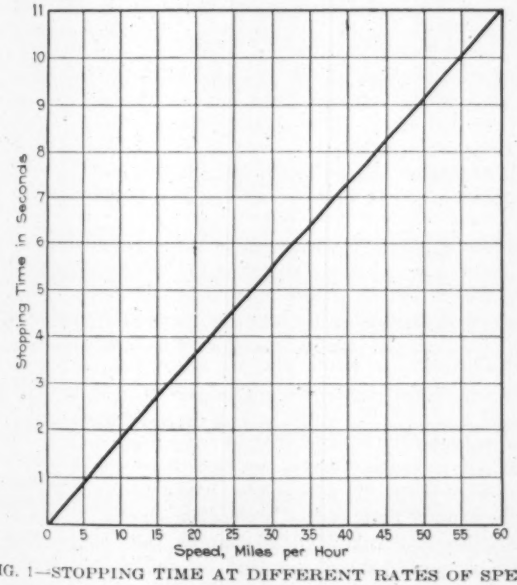


FIG. 1—STOPPING TIME AT DIFFERENT RATES OF SPEED

the car stops. In emergencies this deceleration may be as high as 10 ft. per sec. per sec., although this increased deceleration is not obtained without discomfort being experienced by the occupants of the cars.

Relative Efficiency of Brakes on Dry and Wet Roads—The grip of the wheels upon the road surface is quite as important as the ability of the brakes to lock the wheels. A good grip on the road as well as sufficient brake power is required to bring a car to a prompt stop. The grip depends upon the nature of the road surface and not upon the brakes. On a dry asphalt or concrete pavement the coefficient of adhesion is about 0.64. When the pavement is wet it is reduced to about 0.38 and when greasy to as low as 0.06. On a wet asphalt or concrete pavement it would require

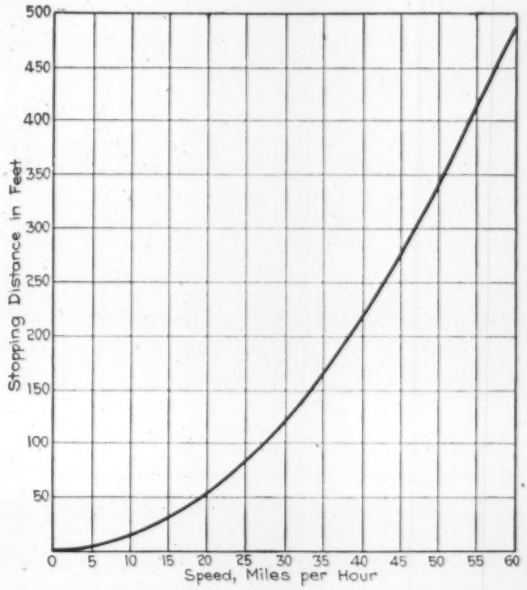


FIG. 2—STOPPING DISTANCES AT DIFFERENT SPEEDS

about twice as much distance to stop a car as would ordinarily be the case if it were dry and if the pavement were greasy about ten times the distance. A severe application of the brakes when the pavement is greasy would result in a skid. Safety is assured when the pavement is in this condition only by operating the car at not over one-third its normal speed. If a greasy roadway is sanded, then, of course, adhesion is increased and a greater speed than this is permissible.

Stopping Time—The fastest speed a car can go and yet be stopped within one second with a deceleration of eight feet per sec. per sec. is 5.4 miles per hour. In other words, if a car is traveling faster than this, it will take longer than one second to stop it. Thus a car going 30 miles an hour upon the application of the brakes is still after one second of their application traveling at the rate of 24.6 miles per hour. After two seconds' application, its speed is retarded to 19.2 miles per hour; after three seconds, to 13.8 miles per hour; and after four seconds to 8.4 miles per hour. The car is not brought to a dead stop until the brakes have been applied 5½ seconds. A car with an initial speed of 40 miles is still running seven seconds after the application of its brakes; one with an initial speed of 50 miles, nine seconds; and one with 60 miles, eleven seconds. A car with an original speed of 60 miles an hour is still forging ahead at 30 miles an hour after a car running 30 miles an hour has been brought to a complete halt.

Speed and Stopping Distance—The time within which a machine can be stopped varies directly as its speed; the distance within which it can be stopped as the square of its speed. Twenty miles an hour is a plebeian speed, yet a car traveling at this rate covers 29 ft. every second. A car running 40 miles an hour covers 58 ft. every second; one 60 miles an hour, 88 ft. It takes almost four seconds to stop a car traveling 20 miles and eleven seconds one traveling 60 miles an hour.

Before a car moving 20 miles an hour can be stopped, it has covered a distance of 54 ft. If the speed is increased to 40 miles an hour, the distance demanded for stopping is increased to 215 ft. A car racing along at 60 miles an hour cannot be stopped until it has covered 484 ft. Every time the speed is doubled, the distance required for stopping is quadrupled.

Fig. 1 shows the time and Fig. 2 the distance in which a car going at different speeds can be stopped.

Effect of Grades on Stopping Distance—The effect of grades on stopping distance with dry pavements is to increase that distance by about 36 per cent when going down a 10 per cent grade and when going up a 10 per cent grade to shorten the stopping distance by about 21 per cent. On 5 per cent down grades the distance required to stop increases 15 per cent and on 5 per cent up grades diminishes 12 per cent. When the street is wet or greasy the increased distance required to stop in going down hill is very much more. When the grade exceeds 5½ per cent on an asphalt, concrete or wood block pavement, and the pavement itself is wet and

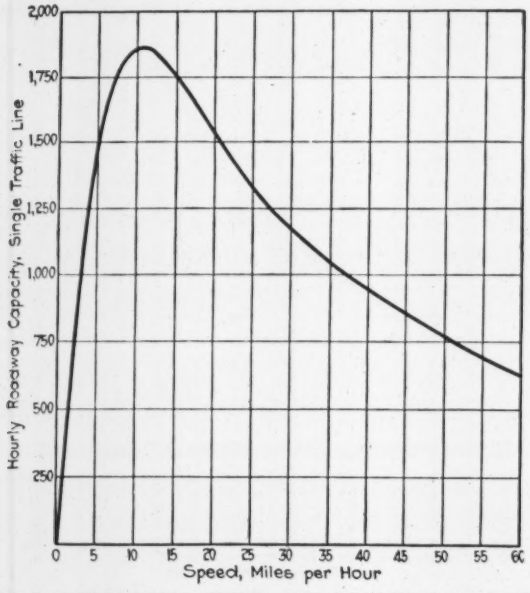


FIG. 3—AUTOMOBILE SPEED AND ROADWAY CAPACITY

greasy, a situation is created where the brakes cannot hold against the force of gravity. The importance of a satisfactory coefficient of adhesion in the case of wet and greasy pavements on steep grades is therefore apparent. The grip of the wheels on a slippery pavement may be considerably augmented by sanding the roadway.

Effect of Load Upon Stopping Distance—The load on a vehicle has but little to do with its ability to stop. The retarding effect of the brakes increases with the load. So much of the load on trucks bears on the rear

TABLE I—SPEED AFTER APPLICATION OF BRAKES FOR DIFFERENT PERIODS.

(Deceleration 8 ft. per second per second)

Original Speed, M.P.H.	Remaining Speed, Miles per Hour After— 1 Sec.	2 Sec.	3 Sec.	4 Sec.	5 Sec.	6 Sec.	7 Sec.	8 Sec.	9 Sec.	10 Sec.
5	....	....	....	....	....	....	....	....	....	....
10	4.6	....	....	....	....	....	....	....	....	....
15	9.6	4.2	....	....	....	....	....	....	....	....
20	14.6	9.2	3.8	....	....	....	....	....	....	....
25	19.6	14.2	8.8	3.4	....	....	....	....	....	....
30	24.6	19.2	13.8	8.4	3.0	....	....	....	....	....
40	34.6	29.2	23.8	18.4	13.0	7.6	2.2	....	....	....
50	44.6	39.2	33.8	28.4	23.0	17.6	12.2	6.8	1.4	....
60	54.6	49.2	43.8	38.4	33.0	27.6	22.2	16.8	11.4	6.0

TABLE II—TIME AND DISTANCE REQUIRED IN WHICH TO STOP CAR AS WELL AS ROADWAY CAPACITY FOR DIFFERENT SPEEDS

Miles Per Hour	Feet Covered Per Second	Seconds Consumed Stopping*	Feet Covered Stopping	Spacing of Feet	Roadway Capacity Single Line Vehicles Per Hr.
5	7.3	.92	3.3	18	1,438
10	14.6	1.83	13.4	28	1,836
15	22.9	2.75	30.2	45	1,750
20	29.3	3.67	53.8	69	1,530
25	36.6	4.58	84.0	99	1,333
30	44.0	5.50	121.0	136	1,166
40	58.6	7.33	215.1	230	918
50	73.3	9.17	336.1	361	755
60	88.0	11.00	484.0	499	635

* No interval allowed for application of brake — it is presumed to have been applied instantly.

axle (to which the brakes are exclusively applied as a rule) that they can usually be stopped in less distance with a load than without one. This is true whether the pavement is dry, wet or greasy. If a machine with a load, however, gets out of control it will, owing to the greater mass in motion, do much more damage than a machine without a load.

Speed and Roadway Capacity—An increase in speed by no means increases the capacity of a roadway. Paradoxical as it may seem, the direct opposite is true, for though a fast car may travel between two points more quickly than a slow one, it does so when the roadway is used to capacity only by driving other cars off the highway.

The speed that will pass the maximum number of cars with equal safety is not one of 50 miles an hour, nor one of 40 miles an hour, nor even one of 30 or 20 miles an hour. It is the prosaic gait of 10 miles an hour. A uniform speed of 10 miles an hour will pass a third more vehicles than one of 25 miles; and half again as many as one of 30 miles. A speed of 60 miles will pass scarcely more than a third as many vehicles as one of 10 miles. Even a speed of 5 miles an hour will pass more vehicles than one of 30 and twice as many as one of 60. Fig. 3 gives the roadway capacity for different speeds.

The common impression is that the faster the speed the greater is the number of vehicles which can pass a point in a given length of time. This is true for quite low speeds. Each increase in speed up to a certain point does increase the capacity of a roadway but after a certain speed has been attained, each unit of increased speed requires such an increased spacing of machines that the roadway capacity is diminished.

If accidents are to be avoided, machines should certainly not follow each other any closer than the distance it takes to stop. So great a headway between cars is, however, very indifferently observed among drivers who commonly act upon the theory that they can stop, even at the higher speeds, as quickly as the car ahead. This may be true if they instantly observe when the forward car applies its brake and also apply their own brakes instantly, provided no accident or sudden obstruction bars the progress of the car ahead. Motorists, however, should always be able to stop in season to avoid any obstruction or danger that may suddenly confront them in place of the car ahead.

Not until thoroughfares are planned and traffic regulated with reference to the fundamental characteristics of the motor vehicle will our streets become efficient and safe for both pedestrians and vehicles. We must also consider thoroughfare design and control of traffic in its relations to the variety, number and speed of vehicles which the street is to carry. To utilize a street to

capacity we must, of course, know what its capacity is. Before building new streets we must be sure that the existing ones cannot, through improvement in the regulations affecting traffic, be made to serve the ultimate volume of traffic for which provision must be made.

The frequency of major streets, their width and grade, the sharpness of street angles and curves, the radii for rounding corners, should be determined with reference to the physical characteristics of the automobile, to the anticipated volume of traffic and to the particular requirements of the ground. Acceleration, deceleration, necessary clearance for different speeds, engine power, gear ratio and turning radius, although comparatively new, are nevertheless fundamental considerations in successful thoroughfare planning. And when it comes to regulating traffic, separating fast from slow vehicles, imposing maximum and minimum speed limits, obliging traffic to round central standards at corners, stopping and starting traffic at intersections, are controlling factors which, if ignored, will prove disastrous to the most mobile condition of traffic.

The street and vehicle using the street must be adapted to one another. The city planner must recognize the mechanical limitations of the automobile in laying out and regulating traffic in his streets; the automobile engineer must adapt the mechanism of his machine to the physical limitations of the thoroughfare plan. The automobile engineer is rapidly solving his part of the problem but not the city planner, although a street designed without reference to the machines using it is no less absurd a thing than an automobile built without reference to the streets it is to use.

An All-Steel Grand Stand at Iowa State University

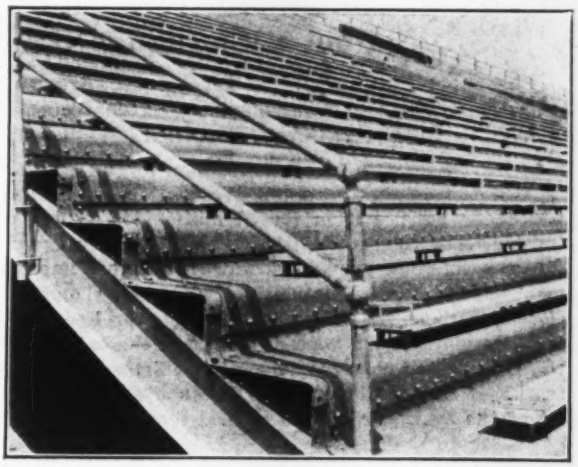
By B. J. Lambert
Professor of Civil Engineering, Iowa State University, Iowa City

Extract of a paper presented at the Iowa Engineering Society annual meeting Jan. 23 to 25 in Des Moines

THE first so-called permanent stands on the Iowa athletic field were built about 1910, of reinforced concrete supported on concrete walls 17 ft. apart. No great care seems to have been used in securing adequate foundations nor in using a high-grade concrete, nor in getting good lines and surfaces. In consequence today there are a number of cracks and breaks and the concrete is in fair shape only. Though it is perfectly safe, yet it is not prepossessing in appearance and cannot be made so by any reasonable expenditure. The great fault with reinforced concrete on small jobs, seems to be the difficulty of securing a competent contractor, one who not only has good intentions but also the experience necessary to do first-class work. Up to 1920 some 6,400 reinforced-concrete seats had been built on Iowa Field, the last section of 1,600 costing about $8 per seat.

On one side of the field is the Iowa River, on the other the Cedar Rapids-Iowa City Electric Ry. tracks. The old concrete stand is twenty rows deep and extends back practically to the river and also to within 10 ft. of the railway. On account of the increasingly great demand for seats at football games, it became necessary to widen our seating space in spite of these obstacles or else move to a new location.

Widening the seating space required building out over the river and also over the electric railway. It was during a study of this proposition that the writer, as chairman of the board in control of athletics, worked out a design for a comparatively light and inexpensive steel structure that was eventually used. It has proved admirably adapted for the purpose.

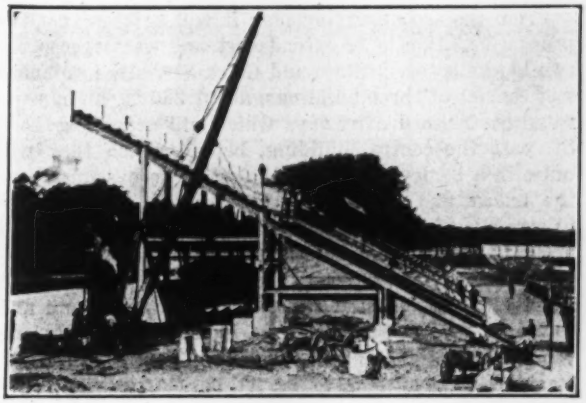


ALL-STEEL GRAND STAND AT IOWA FIELD
Main seat plates are ⅜-in. sheets with 11½-in. risers and 24-in. treads having ½-in. grade. Rivet pitch is 6 in. Cast-iron stools support cypress seats.

The structure, cantilevered out over the river, is supported on a river wall by steel columns designed with sufficient strength to carry a second deck in addition to the present loading. The main 24-in. supporting I-beams and the main seat plates are all built with an adequate factor of safety. Wind bracing is provided in all directions.

Over the electric railway the structure has 18-in. I-beams and 8-in. H-columns, the latter as well as the foundations being designed for a double deck. The main seat plates are of ⅜-in. steel. They are bent Z-shaped with 24-in. tread, and are riveted together at the center of the riser, the upper plate overlapping the lower, thus making this detail waterproof. The supporting I-beams are spaced 17 ft. on centers, and the seat plates are butt-spliced over this beam and also bolted to its upper flange.

The contract for about 10,000 seats was let for slightly less than $50,000. This included fabrication, erection and two coats of paint. The whole work was completed in three months. Foundations of sufficient size to carry a second deck cost about 50c. per seat. The cypress plank forming



ERECTING CANTILEVER OVER RIVER AND RAILWAY
Stand is 85 ft. wide and has 40 rows of seats plus a distributing aisle.

the seat proper is supported by cast-iron stools spaced 4 ft. on centers. These stools stand about 4 in. high and are fastened to the main plates by machine bolts screwed into tapped holes. The cost of this plank seat construction in place and painted two coats was about 50c. per seat. The total cost of the structure complete was therefore about $6 per seat. The design has been patented.

Proposed State St. Terminal Station at Chicago

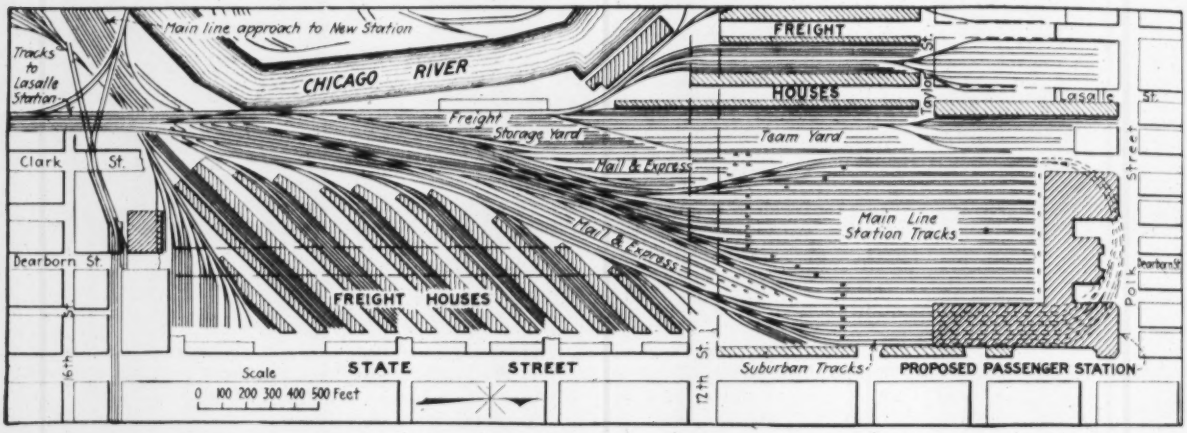
Passenger Station with 37 Tracks and Through Loop for Suburban Trains—Extensive Freighthouse Facilities

A PROJECT for the reconstruction of the Dearborn Station of the Chicago & Western Indiana R.R. at Chicago, with provision for 37 station tracks and extensive freighthouse facilities, is the latest development in the numerous plans for railway terminal improvement in Chicago. This station, which faces and thus closes Dearborn St. at Polk St., lies between Federal St. and Plymouth Court, with an annex on the east side of the latter, giving a present total of thirteen passenger tracks. Combined heavy main line and suburban service of the owning road and several tenant lines results in such congestion of traffic that increased facilities have been under consideration for several years. In view of the central location it was held desirable to provide these facilities on an enlargement of the present site.

From the accompanying plan it will be seen that the proposed station is to extend east and west across the two blocks between State and Clark Sts. Its headhouse will consist of three buildings, about 260 ft. high, separated by inclined driveways which will carry Dearborn St. past the central building, behind which they will unite in a boulevard viaduct 120 ft. wide passing above the tracks and intersecting streets and coming down to street level again at 15th St. This arrangement will not only avoid the intersection of north and south boulevard traffic with the very heavy traffic on Roosevelt Road (12th St.) but will also provide a new north and south artery, since Dearborn St. is not now a continuous thoroughfare. The city is widening Polk St. to 90 ft. and the headhouse is to be set back from the street line so as to provide a plaza in front of the station.

A four-track main line which passes under the railways using the La Salle station farther north is developed into an eight-track approach which fans out into 28 station stub tracks. A two-track suburban line diverging from the east side of the main approach fans out into nine depressed tracks. These suburban platform tracks on a grade of 0.69 to 0.4 per cent unite beyond the platforms in a double track line looping under the headhouse and rising on a 1 per cent grade to pass out along the west side of the station. It is estimated that with this loop arrangement the capacity of the station will be equivalent to that of forty-six stub tracks. The ratio of approach tracks to station tracks is 1:3½ for the 28 stub tracks and 1 to 2¼ for the suburban tracks, taking the latter as equivalent to 18 tracks in view of the loop connection.

From the undercrossing already mentioned the approach tracks will rise on a 1 per cent grade to El. 12 and then descend on the same grade to the station tracks. The suburban lines entering on the east side will have descending grades of 0.69 and 0.4 per cent to the loop and will then rise on a 1 per cent grade along the west side. From a concourse at street level, or El. 14, easy ramps will lead down to platforms about 3 ft. below that level, the rails of the stub tracks being at El. 10. The suburban platforms will be a little lower, but also reached by ramps instead of stairways. The loop tracks will be 13½ ft. below the main station tracks, or at El. —3.5 (3½ ft. below mean water level in the river).



PLAN OF PROPOSED CHICAGO TERMINAL FOR CHICAGO & WESTERN INDIANA R.R.

Electrification will be necessary for the full execution of the project, since the suburban loop and the air-right developments over freight tracks cannot be carried out with steam operation. Mail and express facilities are arranged on both sides of the main approach, and freight facilities are located in the area between the approach and State St. The freight tracks would be at El. 5, or about 9 ft. below street level. For the initial stage it is proposed to have single-story freighthouses and driveways at track level, the driveways opening from a wide space parallel with State St. For future development, however, the foundations and substructure provide for high buildings over the freight tracks. In view of the possibility that the railways now using the La Salle Station might use the new State St. Station a track connection with the main line approach of the latter has been provided, together with a tentative layout of freighthouses in the space between the new station and the river.

A study of this project for an immense Chicago passenger and freight terminal was suggested by H. G. Hetzler, president of the Chicago & Western Indiana R.R. The present plans were prepared by Alfred Fellheimer, architect and engineer, New York, with Steward Wagner and O. S. Payzant as his associates, assisted by E. H. Lee, vice-president and chief engineer of the railroad, and his engineering staff.

Concrete Arch Rib Fails Due to Laitance at Joint

A.A.E. Committee at Tacoma, Wash., Reports on Curious Failures of Part of Highway Bridge in That City

PARTIAL failure of one of three ribs of a skew concrete arch bridge at Tacoma, Wash., last fall caused the closing of the bridge until repairs could be made. The situation was investigated by a committee of the local chapters of the American Association of Engineers, composed of G. W. Osgood, *chairman*, L. A. Nicholson, F. J. Walsh and L. D. Jenson. The main features of the report are as follows:

The committee as individuals and as a committee visited the arch several times. The final examination was made in company of J. C. Manly, city engineer, who furnished the committee with plans of the arch and offered every facility for our examination.

The arch is of the elliptical skew type built on the center line of Tacoma Ave., and spans the Northern Pacific R.R. tracks which intersect the center line of Tacoma Ave. at an angle of about 45 deg. The arch supports an earth fill extending from the abutments to about 6 ft. deep over the crown and carrying the street car and roadway traffic on Tacoma Ave.

The span of the ellipse is about 85 ft. and the rise 30 ft. The width of the arch is 60 ft., divided into three sections 18, 16 and 18 ft. wide (see drawing), with their sides parallel to Tacoma Ave. The abutments of the arch are parallel with the Northern Pacific tracks or 45 deg. to the center line of the arch. As no bond was provided between the three sections, the arch was really three separate arches and was so designed.

The west sections failed at about the third-point on the south end. All other sections are in good condition so far as can be determined by superficial examination. The failure developed a crack entirely across the rib section. From the inside of the arch the crack showed an opening of a couple of inches at the east end, ending in a myriad of cracks and spalling of the concrete under the spandrel wall at the west end.

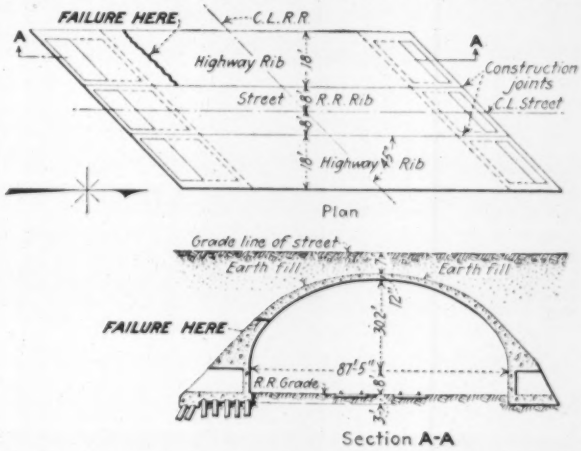
At the east end of the crack the wall crowded in an inch or more, probably due to the pressure of the earth back of the arch. On the back of the arch the crack was equally well defined, though the concrete showed close contact at some points. However, along most of the way there is a more or less regular opening of one or two inches. A number of the vertical reinforcing bars had been wholly fractured and some were partially fractured. The remaining vertical steel was greatly elongated and twisted, showing the arch ring to be approaching a complete failure and collapse.

Examination showed that the crack followed an emergency joint in the concrete. The joint was not normal to the ellipse, but horizontal, and naturally offered no resistance to shearing stresses set up by the thrust of the arch ring along the plant of the joint, which were augmented by the thrust of the earth fill behind. Laitance from ½ to 1 in. in thickness was found in various parts of the crack together with a few scraps of wood and rubbish. As water had been seeping through the crack for several years, it is probable that the laitance had been partially washed away and jarred out due to vibration of trains and street cars. From this it is assumed that the original laitance plane was greater than was found on examination.

In general, the concrete on the entire arch was hard and dense and of good quality.

On examination of emergency or day's work joints in other sections of the structure numerous layers of laitance were found from ½ to 3 in. thick. It is the opinion of the committee that no importance was attached to the formation of laitance on any part of the job, and that no attempt was made to prevent or to remove it. It is understood that during construction the concrete was brought up to about the point of failure when the forms were found to be giving. Concreting was suspended until the top of the arch forms had been loaded sufficiently to counteract the weight of the concrete. Concreting on this side was not resumed until the entire opposite half of the arch ring had been concreted, a period of about ten hours. Apparently a thick layer of laitance which formed on top of the original concrete was not removed and naturally resulted in a joint with practically no bond. In time, with water continually seeping through together with vibration from trains and street cars, the laitance in the joint washed and jarred out, leaving an open crack which increased in size as the wall below moved in.

A theory of the cause of the failure has been advanced by the superintendent of construction for the contractor building the arch to the effect that the concrete at the joint had received its initial set before resumption of pouring, and that workmen sent down into the forms to clean out



SKETCH SHOWING CRACK IN TACOMA, WASH., BRIDGE

debris broke up the green concrete by walking on it and destroyed its bond value. This is not the opinion of your committee. It is the conclusion of the committee that the cause of the failure of the arch was due primarily to lack of bond due to laitance left in the emergency joint, augmented by the fact that the joint was not made normal to the thrust of the arch ring.

The benefit to be derived by the members of this association from this failure and the subsequent examination will be to impress on them the danger of and the cause of laitance. No further discussion is needed regarding the danger. The cause and the cure may be covered under one heading: Too much water or too wet a mixture.

Death Rates in 19 Large European Cities

The 1921 death rates per 1,000 in 19 large European cities (see table) ranged from 21.88 for Rouen to 10.34 for Amsterdam, according to figures compiled by the New York City Health Department. The corresponding rate for New York City was 11.17, but it is not strictly comparable with the figures for France, Belgium and Holland, given in the accompanying table, since in those countries deaths of newly born children occurring before the registration of their births are not included, whereas the New York records include deaths of all infants born alive.

DEATH RATES IN 19 CITIES OF EUROPE, 1921

Rouen	*21.88	Liverpool	14.27	Brussels	*12.29
Budapest	20.35	Manchester	13.81	Hamburg	12.13
Vienna	15.44	Bradford	13.72	Bremen	11.71
Glasgow	15.11	Munich	13.31	Birmingham	11.27
Paris	*14.43	Cologne	13.16	Stockholm	11.07
Milan	14.39	London	12.46	Amsterdam	*10.34
		Dresden	12.45		

* Deaths of infants before registration of births not recorded. See text.—EDITOR.

From Job and Office

Hints That Cut Costs and Time For the Contractor and the Engineer

Determining Pile Locations Under L-Shaped Column Section

By Jacob Feld
Brooklyn, N. Y.

A SIMPLE method for determining the center of gravity of an L-shaped column requiring no computation and no scaling outside of drawing the column section to scale is as follows:

Referring to Fig. 1, consider *ABCDEF* as made up of the two rectangles *ABCa* and *aDEF*, by drawing diagonals find the center of each, *d* and *c*, and connect these two points. Similarly from *AFEb* and *bBCD* obtain line *fe*. The intersection of these two lines, *g*, is the center of gravity of the entire section.

The proof is based on the theorem that the center of gravity of two bodies is on the line joining their centers of gravity. The footing for the column may be either L-shaped or rectangular. In either case, the center of gravity of the pile cluster, where piles are used, must be under the center of gravity of the column section. Otherwise, the piles will be unequally loaded and non-uniform settlement will follow. The pile locations are usually governed by the property lines. Figs. 2a, 2b, and 2c show the cases of 3, 4 and 5-pile clusters located by a simple graphical method. Draw the axes parallel to the external faces of the column at the minimum allowable distance of the center of pile from the building line. Through the center of gravity of the section, *G*, draw a line parallel to one axis, obtaining point *a*. In Fig. 2a, the case of three piles is shown, *ab* is twice *oa*, and *c* is the intersection of *bG* (produced) and the other axis. The proper location of the piles is then, one at point *b* and the other two spaced symmetrically about *c*. Since the distance of the center of a pile from the building line cannot be less

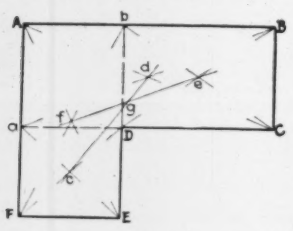


FIG. 1 — FINDING CENTER OF GRAVITY OF L-SHAPED COLUMN SECTION

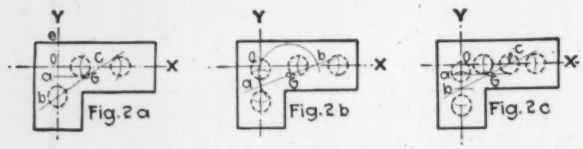


FIG. 2—PLACEMENT OF 3-, 4- AND 5-PILE CLUSTERS UNDER L-SHAPED COLUMN SECTION

than *oe*, the two piles must be on the axis *ox*, and at equal distances from *c*.

In Fig. 2c, we have the case of five piles by the same method, *oa: ab* as 2: 3. The three piles are spaced symmetrically about *c*. This method is not dependent upon the angle formed by the two axes. The proof is as follows: *b* and *c* are the centers of gravity of the 2- and 3-pile clusters. *G* is the center of gravity of the five piles since it is on the line *bc* and since *bG: Gc* as *ba: ao* as 3: 2.

For the special case of perpendicular column faces and equal number of piles under each leg of the L, the very simple method of Fig. 2b may be used. With *G* as center and *Go* as radius, draw the arc cutting the axis at *a* and *b*. Since *aob* is a right triangle, and *G* is equidistant from *a*, *o* and *b*, *G* is on the line *ab*, which is also the diameter of the arc. If two piles are required, they must be placed at *a* and *b*. If any other number is used, half must be spaced symmetrically about each of these two points. Where there are no building line restrictions, the same methods may be used, and the piles are spaced in symmetrical clusters about the points *a* and *b*, with the center to center spacing decided upon.

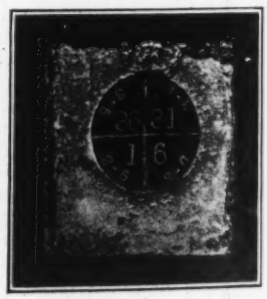
Diagrams drawn to a 1-in. scale will give results which are more accurate than are the best field methods of pile driving.

Brass Plugs Set in Concrete Mark Survey Points in Timber Tract

By George F. Paul
Chicago, Illinois

CONCRETE markers to show the intersection of important survey lines are being used to advantage in plotting a large tract of timber land near Laurel, Mississippi. These markers have been made 4½ in. square and 17 in. long. In the center is a brass or aluminum plug which is screwed on an iron rod and sunk into the concrete; on this plug the numbers are stamped. In the illustration, the township and range figures are the small ones on the outside. The large figures are section numbers.

In this region are many angle lines, some of which date back to the old Choctaw Indian purchase boundaries, and the result is that there is much confusion. In the early days the government would buy and survey a slice of Indian territory running, it might be, from the wigwam of the Big Chief out to some large rock, oak tree, spring, or other landmark. Later, other sales would be made, with the result that there would be great confusion of demarcation lines. In one exceptional instance four concrete posts were needed to establish what should have been one corner.



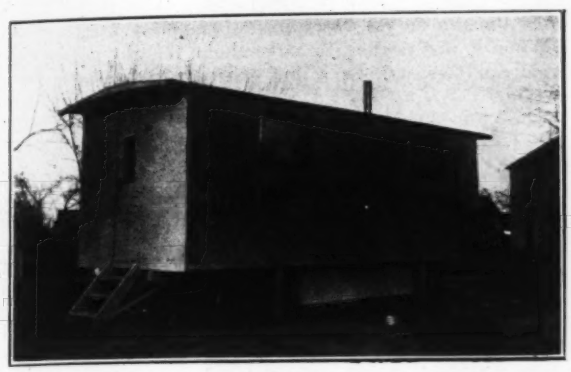
CONCRETE ENCASED PLUGS FOR SURVEY POINTS

Small figures are township and range figures; large figures are for sections.

Contractor Puts Pay Office and Toolhouse on Wagon Trucks

By B. S. Bascome
Huntington Water Corp., Huntington, W. Va.

THE accompanying illustration shows a portable toolhouse and pay office built upon a set of ordinary wagon wheels and used in connection with the construction of a 24-in. cast-iron pipe line. Owing to bad weather conditions, it was necessary to build some sort of protection for the watchman. Inasmuch as this



PORTABLE TOOLHOUSE AND FIELD OFFICE

had to be done, the structure was extended to provide other uses than for housing the watchman.

The wagon is divided into an office and toolroom, the office containing two desks for the timekeeper and superintendent, as well as a drafting table. The toolroom contains a rack for the tools and the walls are pegged for the purpose of hanging up rubber boots, slickers, etc., which are therefore always kept dry and ready for use. The wagon is equipped with hinged supports carried on four screw jacks. Thus the dead-weight of the house can be transmitted to the ground when the wagon is not actually in motion. The house is provided with removable steps which are set up as soon as the wagon is parked and the team removed.

The overall length of the house is 20 ft. and the overall width 8 ft. Of this space 8x11 ft. is occupied by the office, and a space 8x9 ft. by the toolroom.

The writer suggests that this outfit might be valuable to contractors involved in road construction or other work wherein daily moves are necessary to keep up with construction.

False Bents Jacked in Place Strengthen Timber Bridge as Shovel Crosses

By R. T. Brown
General Manager, Piedmont Construction Co., Asheville, N. C.

RECENTLY one of our superintendents used considerable ingenuity in carrying a ¾-yd. shovel across a timber bridge. There was so little clearance between the railings of the bridge that the cab could not be swung to either side to steer the shovel. The superintendent, therefore, had the steering clutch disengaged, leaving the road wheels free. He and one assistant then took two large timber wedges and kept closely in front of the shovel as it proceeded. When it began to crawl too close to one side of the bridge a wedge was thrown in front of the opposite wheel. This held the wheel back until the other gained the necessary advantage and the crossing was made without mishap.

To support the panels between caps, he placed a false cap on struts which in turn rested on jacks. When the load came on the panel the jacks were raised to take care of the deflection. When the shovel rested over the regular bridge cap the false cap and jacks were moved forward to the next panel.

The crossing was made in less than two hours, whereas it would have taken more than a day to place false bents under all panels and to remove and replace the railing.

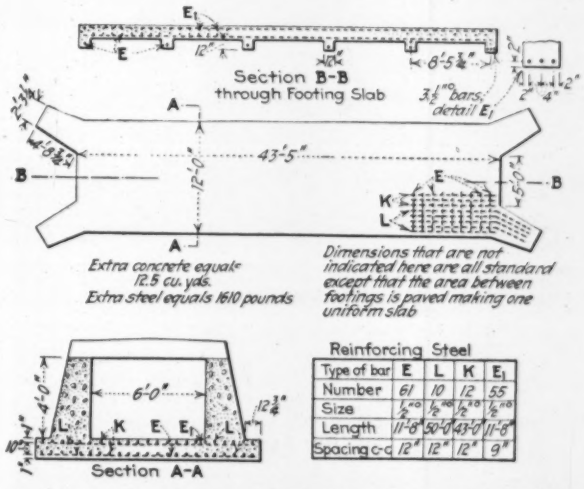
Special Footing for a Culvert

By Paul L. Fetherston
Resident Engineer, Michigan State Highway Department

THE SPECIAL footing shown in the sketch was designed for a standard culvert which was placed on a muck foundation. This soil was water soaked and so soft that a man would sink to his knees when walking in it. A 30-ft. rod was shoved down full length and no suitable footing for piles was discovered.

The size and disposition of the reinforcing steel is shown in the sketch in detail. It is probable that an excess of steel was used but it was thought best to be on the safe side and make sure that a failure would not occur for the lack of a few dollars worth of steel.

In placing this culvert the excavation was carried to a depth of 1 ft. beyond that required for the concrete, then backfilled with coarse gravel. A sloppy 1:3 mix of cement and sand was spread over this to a depth of ½ in. and allowed to set for 24 hours before the


Section B-B through Footing Slab
43'-5"
12'-0"
6'-0"
Extra concrete equals 12.5 cu. yds.
Extra steel equals 1610 pounds
Dimensions that are not indicated here are all standard except that the area between footings is paved making one uniform slab
Section A-A
Reinforcing Steel
Type of bar | E | L | K | E1
Number | 61 | 10 | 12 | 55
Size | 1" sq. | ½" sq. | ½" sq. | ½" sq.
Length | 11'-8" | 50'-0" | 43'-0" | 11'-8"
Spacing c-c | 12" | 12" | 12" | 9"

HEAVILY-REINFORCED CONCRETE CULVERT FOOTING

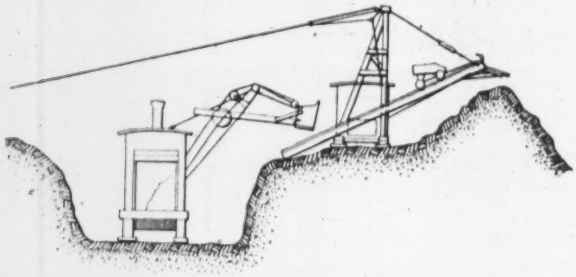
footing was poured. This was done in order to make sure that the muck would not mix with the concrete while it was being poured.

In placing the footing a rigid inspection was maintained to make sure that all water was removed from the excavation and that the concrete was properly mixed and the steel placed as specified. A 1:3:6 mix was employed.

This culvert has now been in place for a season and levels taken on the headwalls from time to time indicate that there has been no settlement to date. The structure appears to be sound throughout.

Skip on Portable Incline Supplements Steam Shovel in Excavation

A PORTABLE, inclined track with a power-operated skip used in the excavation of the canal for the Hat Creek No. 1 hydro-electric plant recently built by the Pacific Gas & Electric Co. in northern California, made it possible to use a steam shovel of ordinary size for excavating a canal 10 ft. deep and still maintain a wide berme along the edge of the canal. The canal is 17 ft. wide at the bottom, has side slopes of ¾ to 1

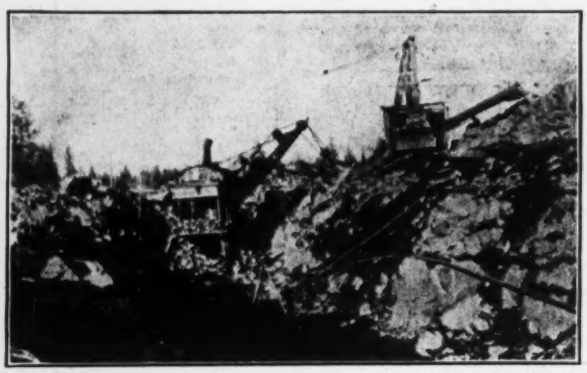


SKETCH SHOWING RELATION OF SHOVEL AND INCLINE

and in its length of 2,600 ft. required the removal of about 24,000 cu.yd. of rock and earth.

This yardage did not warrant taking a special, large-sized shovel onto the job, which is in a remote district, and the plan worked out called for only such equipment as was conveniently available. A 2-in. compressed-air line was already laid along the canal for serving rock drills and this line was tapped at intervals for power to operate the skip. Under the plan devised the shovel dipper delivered to a skip operating on an inclined track built upon a heavy skid frame, which also carried a double-drum air-driven hoist. The incline was braced and guyed with the aid of a tower, as shown in the accompanying illustration, and material dumped from its upper end was delivered 20 to 25 ft. from the edge of the canal.

The incline was made of 12x12-in. timbers with 6x6-in. braces and 1-in. iron tie-rods. Two pairs of rails were used, the front wheels fitting the inner pair



STEAM SHOVEL IN CANAL SERVING CONVEYOR ON BERME

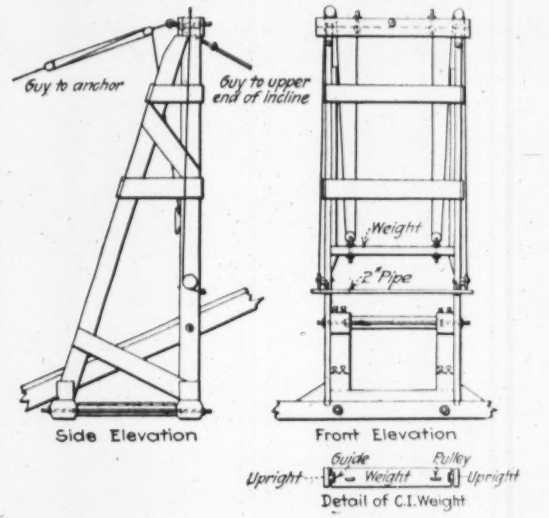
and the rear wheels the outer pair, so that automatic dumping at the upper end of the incline could be accomplished in the usual way. At the top of the incline the outer rails were bent up to form a bumper, while the inner rails were bent down at an angle of 45 deg.

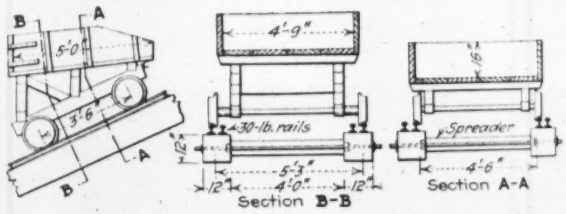
From Job and Office

Hints that Cut Cost and Time

At the outset the empty car did not readily start back down the incline. This was overcome by arranging a weight, as shown in the illustration, so that when the loaded car was pulled up in the last few feet of its travel it raised a counterweight. This counterweight in turn started the skip back down the incline when tension on the hauling line was slacked off.

When it was desired to move ahead the guy across the canal was released and a line was carried to a deadman





DETAILS OF INCLINE, SKIP AND COUNTERWEIGHT

some distance ahead. Power for moving the entire outfit on its skids was provided by the same hoisting engine which operated the skip.

The work was done under the direction of O. W. Peterson, construction engineer for the Pacific Gas & Electric Co. and James Martin, superintendent of construction.

Why City Engineers Go Crazy

In reporting the difficulties of a contractor who ran into 10 ft. of wet quicksand at the bottom of a 50-ft. pit under heavy surcharge, a contemporary remarks that the contractor's organization proceeded to *punch holes* into a 10-ft. sewer under the cut. Through this sewer the troublesome quicksand was speedily drained enabling the contractor to complete retaining walls and abutments without the extraordinary expense and delay that otherwise would have been necessary.

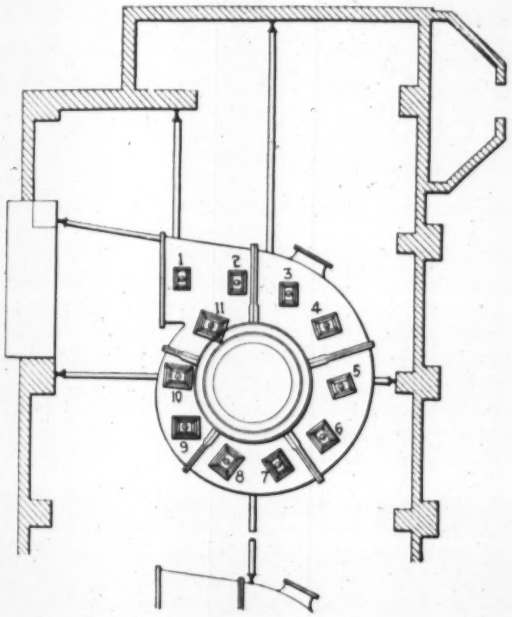
From Job and Office

For Contractor and Engineer

Time Saved in Aligning Turbine Casings by Leaving Jacks in Concrete

SCROLL casings for the two hydraulic turbines in the Pit River power house No. 1, recently installed by the Pacific Gas & Electric Co. in northern California, were aligned, leveled up and held in position by jacks, most of which were left in place when the concrete was poured. The loss of the jacks embedded in the concrete was negligible as compared with the time and labor saved in adjusting to exact position the casings which weighed about 105 tons each.

The assembled casing, ready to be embedded in concrete, was lowered to place and rested on eleven jacks, each supported on a concrete pier. These piers ranged



PLAN SHOWING LOCATION OF JACK PIERS AND PIPE BRACES

All but 9 and 10 were concreted in, these two being in an opening left for the removal of runner.

from 3 ft. 3 in. to 5 ft. 7 in. in height and all four sides had a batter of 9 in. in 5½ ft. The piers were reinforced with six ½-in. square bars extending 2 ft. 6 in. into the supporting slab and braced by ¼-in. stirrups placed 1 ft. apart vertically. The tops of all piers were made 12x18 in. in size. Piers 9 and 10 were portable as they came in the opening for removing the turbine runner. These two piers were cast with handles made of ¾-in. reinforcing steel to allow them to be safely and readily moved with a derrick.

By turning up the jacks to take the weight of the scroll casing the exact level desired was secured. At the same time, to secure the desired alignment in a horizontal plane, jacks were turned up on six horizontal braces of 4 and 6-in. pipe placed between the casing and the walls of the pit, with jacks at the wall ends.

Where the jacks could be salvaged the hydraulic type was used, elsewhere 2-in. screw jacks, with a capacity of 20 tons and costing about $5 each, were used. When the concrete had set the horizontal pipe braces projecting from the walls were cut off with an oxy-acetylene torch.

One of the concrete piers started to fail at the top, due to the concentrated load imposed on it by the jack.

LINING UP SCROLL CASING WITH JACKS ON PIERS AND PIPES

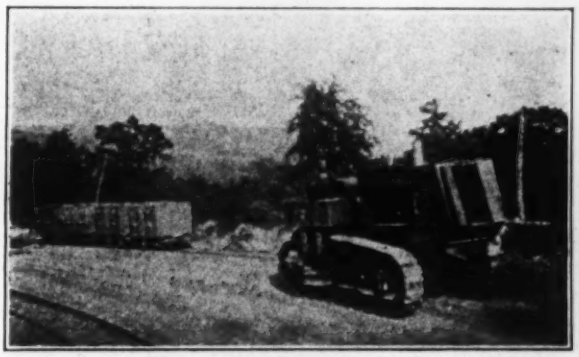
This was remedied by putting ⅛x4-in. iron straps around the pier at the top. Where jacks with small bases are used it is therefore recommended that steel base-plates be provided.

The installation was made by the Pacific Gas & Electric Co. under the direction of O. W. Peterson, construction engineer, and James Martin, superintendent.

Tractor Hauls Industrial Trains on Heavy Grade in Road Work

BY CROSBY TAPPAN
Superintendent of Construction, Pennsylvania Highway Department

IN THE highway recently completed by the construction bureau of the state highway department in the vicinity of Franklin, Venango County, Pennsylvania, there was a grade 1¼ miles long ascending from the railroad siding where the unloading of materials was



10-TON TRACTOR HAULING TRAIN ON 9 PER CENT GRADE

done. The gradient at certain points ran as high as 9 per cent. Beyond the top of this grade approximately 3¼ miles of road were to be built. The problem to be

solved was to devise some efficient and economical method for hauling the materials up this grade for concrete.

After careful consideration of the use of gear-driven locomotives, trucks, and a combination of trucks and industrial railroad, it was decided to grade the hill first, to lay a 24-in. railway track on each side of the finished grade and then haul trains of cars loaded with filled batch boxes up one track and empties down the other, using as motive power ten-ton caterpillar tractors, which occupied the space between the two railroad tracks. The cars were attached to the tractor by means of a ¾-in. cable about 40 ft. long.

To prevent runaways a piece of heavy iron was placed with one end in the rear knuckle of the rear car, the other end dragging on the ground. This iron was about 3 ft. long and was flattened to a rough cutting edge at the lower end. If for any reason, such as breaking of the cable, the cars started to slide downhill, this "stop" thrust itself into the ground and held the train. To send empty cars down the hill the train was kept attached to the tractor and dropped down with the tractor holding the train back. It was found that the best results were obtained with a tractor speed of four miles an hour. This enabled the tractor to haul as high as six loaded cars up the grade.

Instrument "Speaks" Reservoir Water Level to Distant Engineer by Telephone

By Major R. Johnstone-Taylor
Underdale, Shrewsbury, England

THROUGH combined use of the telephone and the gramophone a recorder has been set up at the Delta Barrage, Egypt, whereby an engineer removed several miles from the reservoir is told the water level therein. The system which thus does away with the services of an attendant at the reservoir has recently been installed by Kents of London.

The recorder can be switched into an existing telephone circuit when information is wanted. One transmitter is used, the ordinary standard telephone

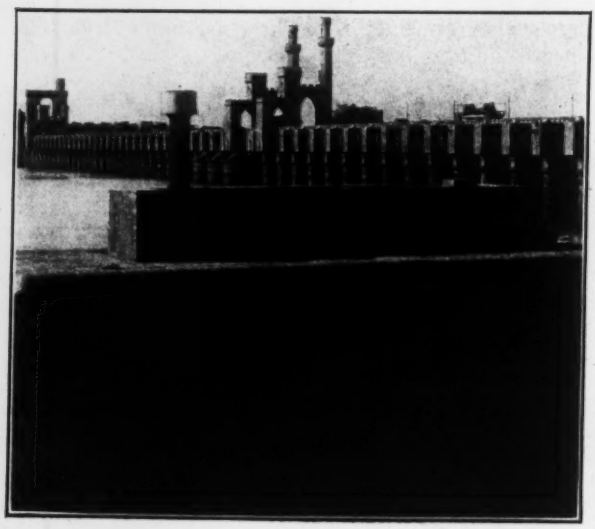


FIG. 1—WATER LEVEL RECORDER AT DELTA BARRAGE, EGYPT
The instrument is seen at the left of the picture with the metallic cover upon it.

From Job and Office

Hints that Cut Cost and Time

FIG. 2—CLOSE UP OF RECORDER

acting as the receiver. The calling is done exactly as in any ordinary 'phone call. Two methods of producing audible signals have been employed: One is by means of a gramophone which states the depth; the other is by means of contacts which give a certain number of clicks to correspond to a certain depth of water in the tank or reservoir.

If the gramophone system be used the apparatus consists essentially of the gramophone clockwork mechanism working in conjunction with a level recorder gear, the mechanism being inclosed in a locked iron case. By a movement of a float resting on the water, the tone arm, sound box and needle of the apparatus are moved laterally into a position with the disk to give the correct reading when the needle is brought into contact therewith. To make the contact a sprocket wheel is geared with the disk spindle of the clockwork mechanism. This sprocket is fitted with a platform and from it a runner travels down a small ramp and by a system of levers and a cord the sound box, with the needle attached, is lowered upon the disk when the mechanism is in rotation with the disk, and raised when the mechanism stops.

The instrument is fixed at the reservoir and connected up in the usual way to the nearest telephone exchange. It is allocated a subscriber's number, which, when asked for, puts the inquirer into communication with the instrument which then speaks to him. Signals are given eight times to avoid any possibility of error through mishearing.

The recording disk is vocalized in 200 concentric circles spread over a distance of 3½ in., the gear reduction between float and tone arm being designed especially for each machine. The disk reads from "empty" to "one double naught," enunciating each digit, that is "seven-two," "seven-two-half," etc.

In the instrument which records by clicks a contact arm is moved parallel to the axis of the drum by the movement of the float. When the 'phone exchange rings the instrument the clockwork is set in motion and the drum rotated. The contact arm makes electrical contact with the drum during its revolution, thus causing a series of sounds to be imparted to the circuit. Signals are sent in groups of three with a longer pause between each set of digits. This is to facilitate reading so that the clicks can readily be heard. Signals are repeated three times, the line is then automatically cleared and is ready to be called again.

From Job and Office

For Contractor and Engineer

Reservoir Spillway Discharge Studies

By F. H. Macy
Assistant Engineer, Bureau of Water Power, Office New York State Engineer and Surveyor

THE writer has used the well-known mass curve of runoff to solve many stream-flow and control problems and finds it convenient when applied to the study of reservoir spillway discharges herein described.

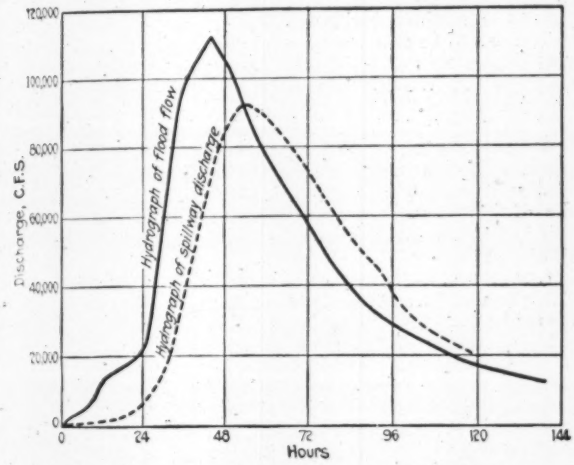


FIG. 1—HYDROGRAPH OF ASSUMED FLOOD RUNOFF

Taking any assumed flood runoff hydrograph, for example that shown in Fig. 1, the discharge for each hour may be determined and reduced to a convenient unit for construction of the mass curve. Knowing the flow area of the reservoir at the crest elevation of the spillway, and the spillway length, curves may be plotted showing the relation between:

(1) Spillway discharge in billion cubic feet per hour and height of water on the crest:

(2) Spillway discharge in billion cubic feet per hour and storage on the crest in billion cubic feet. (Fig. 3).

The problem may be solved graphically or in tabular form as follows:

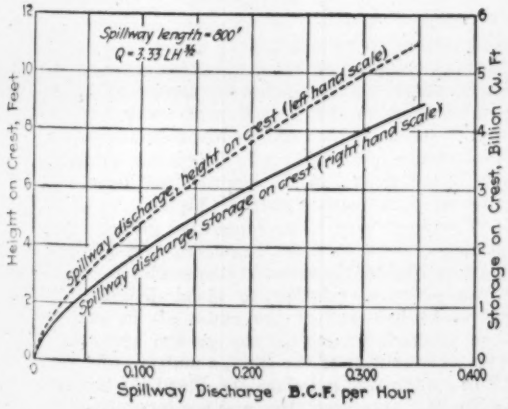


FIG. 3—SPILLWAY DISCHARGE AND STORAGE ON CREST

TABLE I

I	II	III	IV	V	VI
Hour	Flood Discharge Billion Cu. Ft. Per Hr.	Integrated Flood Discharge Billion Cu.Ft.	Discharge Over Spillway Billion Cu.Ft. Per Hr.	Integrated Spillway Discharge Billion Cu.Ft.	Storage on Crest Billion Cu.Ft.
1	.007	.007	0	0	.007
2	.008	.015	.0001	.0001	.0149
3	.008	.023	.0001	.0002	.0228
4	.009	.032	.00015	.00035	.0316
	etc. to				
54	.336	9.615	324	5.392	4.223 Max.

The flows from the hydrograph, Fig. 1, are reduced to billion cubic feet per hour for each hour and placed in Column II. This column is integrated to form Column III, which is the mass curve data for the flood inflow. The assumption is made that the flow for the first hour is all stored on the spillway crest, i.e., no overflow, making Columns IV and V for the first hour equal to 0, Column VI for the first hour being equal to Column III.

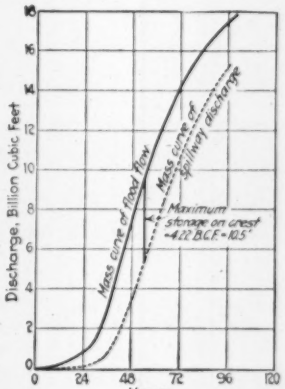


FIG. 2—MASS CURVE OF FLOOD FLOW, SPILLWAY DISCHARGE

The next assumption is that the amount of storage on the crest at the end of each hour, or more strictly the equivalent head, determines the discharge during the succeeding hour. This spillway discharge is derived directly from Fig. 3. (It is advisable to plot the lower portion of Fig. 3 on a large scale as the quantities involved are small.) The spillway discharge having been determined, this is integrated, giving Column V, which is the mass curve of the spillway discharge. Column VI is Column III less Column V. The computation is carried on until the maximum value of spillway discharge is obtained.

The process may also be solved by plotting the mass curve data to some convenient scale. (Fig. 2.)

A somewhat similar method as described above, written by C. C. Jacob, appeared in *Engineering News* June 13, 1912, p. 1134.

Track Inspection Instrument

A simple track recording instrument which is actuated by the oscillations of the train so as to indicate irregularities of line and surface, and which may be mounted in an ordinary car, is being used on the Great Northern Ry., of England. A box about 12x18 in. and 24 in. high contains the mechanism for four recording pens and a continuous strip of paper for the chart. One pen is operated by a bulb held by an observer who thus indicates mile posts, stations, junctions and other points. The others are operated by counterweights and pendulums controlled by oil and pneumatic dashpots. Of these three pens, one records longitudinal oscillations due to braking and acceleration and to rolling motion caused by low rail joints; the second records lateral movements due to bad line or wide gage; the third records vertical motion due to irregular surface of track. From the chart the engineers can locate spots or stretches of track that need attention for proper maintenance.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

More on Mississippi Spillways

Sir—Your issue of Jan. 4, 1923, devoted considerable space to the flood problem on the Mississippi River. The importance of the problem, now that the condition of the lower river has become so critical, appeals to publicity, in order that the real situation may be better understood.

The writer of this letter, who is a member of the Engineering sub-committee of the Safe River committee of New Orleans, and who appeared before the Flood Control committee of the House of Representatives, during December, advocating a spillway in the vicinity of New Orleans as a supplement to the present levee system, wishes to call your attention to what he considers misleading deductions in your presentation of the case.

In your editorial comment you say: "It may be pointed out that each side avoids extensive reference to the main criticism of the other. The spillway advocates are little concerned with the structural stability of a spillway or weir. Col. Townsend dismisses rather lightly the long held contention that the main argument against a spillway is a possible silting up of the river below the spillway. Of the two omissions, Col. Townsend has the better of it in that he is arguing about something that is tangible and assured, the tremendous force of 250,000 sec.-ft. of water and the difficulty of building in the Louisiana alluvium any dam or weir that could withstand it. This is an engineering problem of gigantic proportions and while it is by no means inherently insoluble, its solution involves courage and huge expenditure."

It is true that our committee laid its greatest stress upon the question of the old trite bugaboo of channel impairment below the spillway, and furnished an abundance of good evidence to disprove it, not only in the report from which you quote but also in arguments before the Flood Control committee of the House of Representatives. We did this because the Mississippi River Commission's argument has always been that checking the velocity in the slighest degree by any form of outlet or waste weir would cause impairment by sedimentary deposit greater than the benefit derived from the opening. We had never heard of structural difficulties being offered as argument against the practicability of a spillway.

The Mississippi River Commission in 1895 made an elaborate survey of many cross-sections above, opposite and below the present outlet through Old River, at Red River Landing, into the Atchafalaya. In 1910, they resurveyed those same cross-sections and found, in absolute refutation of their theory, that instead of impairment during the intervening fifteen years, there had been a channel improvement of 7.4 per cent.

By order of Congress, the Mississippi River Commission, in 1914, had Col. Clarke L. Smith, U. S. A., make a survey to determine the advisability of a spillway, or spillways, in the vicinity of New Orleans. His report was most gratifying and showed that a spillway 6,000 ft. wide, into Lake Borgne, below New Orleans, would have held the 1922 flood to more than 3 ft. lower stage than was reached. The plan was rejected by the commission on the grounds that it would not be used very often, that the relief was not very great and that it was hazardous and expensive. The first argument is as untenable as would be an argument against fire insurance; the second argument is unsound because that relief, though apparently small would have meant in 1922 the difference between the crevasse and no crevasse. Three feet more relief would have averted the Poydras crevasse. The argument of expense is not sound because the Poydras crevasse was more expensive than the cost of a spillway and we are still liable to other crevasses in the near future. The argument of hazard is a decided reflection on American engineers. Furthermore, if the whole works blow out we would only have a crevasse and we are accustomed to crevasses.

There has been neither improvement from scouring nor impairment from sedimentary deposit in outlets. Insofar as the writer has been able to ascertain the river responds to the calls of cross-section and slope just as if it were a clear stream, the velocity being at all times adequate to carry all the sediment in suspension. The reason the river gets higher than formerly is that confinement by levees forces into it water that formerly rested in natural storage basins until the crest had passed.

The contention of our committee is that the reasonable limits of levee heights will have been reached when the present commission grade and cross-section is attained and the floods will be still far from provided for. We know that additional means of flood control must be provided and see in a spillway the greatest measure of relief at the least expense.

It is inconceivable that engineers who can build the Panama canal, the Roosevelt dam, the Keokuk dam and numerous other similar works would fail on so simple a project as a spillway into Lake Borgne, below New Orleans. A flow of 250,000 cu.ft. per sec. is considerable water, but the weir is 6,000 ft. long, two and a half times the width of the Mississippi River. The maximum flow through it will be 6 ft. deep, and the maximum velocity over the weir less than 7 ft. per sec., just about the same as that in the river past the spillway.

The elevation of the crest of the spillway will be 12.7 ft. above mean gulf level; add 6 ft. for the maximum depth of water over the weir and we have a crest of 18.7 ft. for the water at the spillway. The natural elevation of the ground 600 ft. back of the spillway is just about 7 ft. above mean gulf level and drops practically all of this 7 ft. in the first half mile towards Lake Borgne, when it enters a timbered swamp which is practically gulf level. It is about four miles across this swamp to Lake Borgne.

The spillway plans provide a flexible apron for 600 ft. from the spillway, made of concrete blocks held together by cables, on which apron the force of the water coming over the weir can expend itself.

There will probably be something of a hole dug by the water at the extremity of the apron but, as it tends to dig back towards the spillway, the flexible apron will adjust itself to the configurations of the hole and the digging will cease when a sufficient water cushion is obtained to consume the force of the sudden fall.

The resistance of the stumps and vegetation in the swamp portion of the spillway will be great enough to slow the water down to probably no more than the current in the river; this will mean a depth of 6 ft. through the spillway, which will back up against the weir a sufficient height of water to materially modify the force of the fall. If this is not sufficient it would be no great engineering feat to install retarders to accomplish the desired purpose.

Instead of thinking of this proposition in terms of 250,000 sec.-ft. of water, which carries the terrors of huge volume with it, let us think of it as a flow of water 6 ft. deep over a dam 5 ft. high. It then sounds less formidable.

The structure will be on a pile foundation similar to those used in New Orleans, in the identical soil upon which rest buildings more than twenty stories high.

Col. Townsend says "The committee invites attention to a fact long known to river engineers that the amount of sediment carried by the river in suspension at New Orleans bears an obscure relation to flood heights, but they appear to be ignorant of the cause of the phenomenon." He then proceeds to explain the greater turbidity of Missouri water over that of the Ohio, a matter quite thoroughly gone into by the writer before the Flood Control committee of the House. Our committee was not ignorant of the cause of this turbidity condition but the cause was not at issue. We were refuting the contention heretofore expressed of the

Mississippi River Commission that a spillway would cause dangerous deposit due to diminishing velocity.

Col. Townsend also says "They also emphasize another well known fact that the river discharge, at a given stage, constantly varies. A river's discharge is dependent not only on the area of its cross-section but also on its slope." He then goes on to show that the discharge in 1916 was greater for a given stage than was the case in 1912 or 1922, because the flood of 1916 was of short duration and the storage reservoirs at the mouths of the tributaries were not all filled up and the slope consequently was greater than in 1912 and much greater than in 1922.

The committee appreciated these facts and the writer concurs entirely with Col. Townsend in his deductions. What we were endeavoring to show, and what we complain of, is that the closing of the natural storage basins has brought about the condition which has diminished the capacity of the river at New Orleans, for a given stage, twenty per cent since 1851. The choking of the river, particularly in the lower reaches, prolongs the floods until practically all of the storage area becomes filled and the slope becomes more nearly uniform and consequently gentler, which means less discharge for a given stage. We are not a little surprised to note that while Col. Townsend admits this he still persists in a policy which can mean nothing but failure and ruin, for it is obvious that the capacity of the river has been diminished beyond any reasonable hope that levee heights can compensate in cross-section for the loss in slope due to the closing of the natural storage basins.

[Mr. Kemper here included in his original letter a criticism of Col. Townsend's flood figures based on the reference in the Townsed paper to the Vicksburg stage "on April 18." As this was a typographical error in the original paper, the the intention being to refer to "April 28," Mr. Kemper's criticism does not seem valid and is therefore not included.—EDITOR.]

Col. Townsend was again mistaken when he says that the Cairo stage exceeded 50 ft. for 55 days during the flood of 1922. It reached 50 ft. on March 20 and passed under the 50 ft. mark on May 2, remaining 50 ft. or more for 44 days. That this is long enough is admitted, but it caused no alarming stages between Cairo and Memphis. The Memphis gage did not get within 4.5 ft. of the 1913 record while the Arkansas City gage, 200 miles below Memphis, showed 2.9 ft. higher than it did in 1913. This variation of 7.4 ft. was caused wholly by the closing of the Cypress Creek gap, referred to by Col. Townsend, which shut water out of the Tensas basin at the mouth of the Arkansas and forced it into the Mississippi River. It can not be accounted for by the high condition at Cairo, however much the Mississippi River Commission would like to use that route for an alibi, for the reasonably low stage at Memphis was between to disprove it.

There is just one ray of hope in Col. Townsend's most interesting paper and that is contained in these words—"The principal lesson to be derived from the flood of 1922 is the vital importance of maintaining the existing spillway at the mouth of the Red River." The commission periodically votes on closing this opening into the Atchafalaya. At their last vote on the subject the engineers were divided three to three and the lay member saved the situation by voting, as he told me, his common sense. He saw that great volume of water leaving the Mississippi into the Atchafalaya, with the tops of the levees barely out of water, and his common sense told him if that additional burden was placed on the river the levees would be overtopped. It is the writer's opinion that they would be overtopped about 6 ft., just as the Arkansas City stage was raised 7.4 ft. by closing the Tensas opening.

Our committee believes that the only hope for flood relief is thoroughly intelligent information. The public in general and our legislators in particular have been deceived by false theories. We think the Mississippi River Commission should either defend its actions on their merits or acknowledge their error. They seem disinclined to do either. We feel gratified, however, over the progress made in Col. Townsend's admission that the opposition to spillways is now based only on structural difficulties and not upon channel impairment, as the commission has falsely preached for forty-three years.

We know that a spillway will cost no more than a very mediocre crevasse and we know if the spillway were to blow out it would only be a crevasse and we are accustomed to crevasses. We also know that, if the Mississippi River Commission has no engineers competent to build a spillway there are private concerns that for a reasonable consideration will build it and bond it against blowing out.

The commission has the authority to build spillways and it is our purpose to so bombard it with truth that it will be unable to stand the pressure of a righteous opposition and rescind from its present arbitrary and not entirely consistent position.

J. P. KEMPER,
Civil Engineer.

New Orleans, La.,
Jan. 18.

Sir—In your issue of Jan. 4 you state "Col. Townsend dismisses rather lightly the long held contention that the main argument against a spillway is the possible silting up of the river below the spillway." It is unfortunate that he has done so for that is the crux of the whole matter.

The organic law creating the Mississippi River Commission in 1879 provided that "the commission shall report in full upon the practicability, feasibility and probable cost of the various plans known as the jetty system, the levee system and the outlet system as well as upon such others as they deem necessary." In obedience to these instructions the commission began the collection of data from all available sources, including the experiences in foreign lands, and the studies extended through a period of several years. In fact the study of the effect of outlets and crevasses on the bed of the river has been continuous up to the present time. And the conclusion was reached that any outflow of material volume from the main stream reduces the capacity of the main stream below, through deposits of sediment, whether the outflow is an outlet, a spillway or a crevasse. It is merely a question of the extent of the reduction of section and not a question of fact.

The data gathered from the early experiences of crevasses in Louisiana and data gathered since by actual surveys made by the commission before and after many crevasses, all bear out the correctness of the conclusions above cited. There have been many attempts to explain away the results, but actual facts and figures to disprove them are still lacking. Furthermore, experiences of many years in other lands where great sedimentary rivers have been bled by numerous irrigation canals, show that the rivers have silted up to such extent that they are no longer able to carry anything like their former volume.

Neither is it important to differentiate between outlets and spillways or crevasses. Assume a spillway connecting the Mississippi River and Lake Borgne in operation during the flood of 1922. As soon as the outflow begins, the deposit of sediment in the river below follows and continues until the bankful stage or top of weir is reached on the recession of the flood. There is found a decided reduction in the section of the river below and a material loss in its carrying capacity, depending in a measure on the volume and duration of the outflow. In the case of the Polydras crevasse of 1922 the measured decrease in section amounted to about 7 per cent. In one case measured the decrease amounted to 24 per cent. The danger lies in the loss of carrying capacity.

Assume an overflow of 250,000 cu.ft. per sec., what will be the actual reduction in flood stage? A study of the actual discharge measurements at Carrollton would indicate that the abstraction of so large a volume from the river should reduce the stage about 4 ft. The actual reduction according to gage readings is however only 1.6 ft. There is only one way to account for this and that is, the reduction of the channel capacity below the weir formed by the deposits has required that much increase in stage in order to carry off the volume put upon it. That is why the reduction in stage looked for from a spillway can never be realized and will always be disappointing.

It is not now and never has been a question of navigation

below Baton Rouge where the navigable depth of water is ample at all stages of the river. As the river carries a maximum of over 1,500,000 cu.yd. of sediment per day past the spillway site, is it any wonder that the channel capacity is reduced, a part of the sediment dropped, due to the depleted volume? The outflow through the spillway is from the surface where if anything the percentage of sediment is the lowest.

In every case where the effect of crevasses on the bed of the river has been measured a reduction of section has been noted and the lowering of the stage of river due to the crevasse has not been commensurate with outflow volume.

The river again within its banks or below the crest of the weir, the assumed spillway has no further influence until the next flood comes, and this may be an interval of several years. When it first became effective, the channel conditions were the resultant of several succeeding confined flood stages and the usual low stages. It seems probable that like conditions would be required to restore the channel to the conditions which existed when the spillway outflow began. That is to say a channel developed by a flow of 1,500,000 sec.-ft. once depleted by a crevasse or spillway outflow, could only be fully restored by a volume equal to that which created it.

The length of river covered by the reduction in section has never been determined but is not important as the reduction in volume of flow is measured by the area of the cross-section and the velocity due to the local slope. The extent to which the deposits may be cumulative has not been determined. That there will be some removal of the deposits due to scour between bankful stage and low water seems inevitable.

Rivers in foreign lands which have been under observation for many years definitely show a cumulative deterioration of the lower reaches where the volume higher up has been largely depleted.

After an extended series of observations before and after crevasses, of crevasses open and closed, the commission stated its conclusions: "That the loss of volume through high water outlets caused both a diminution of velocity and a deflection of the thread of movement of the stream towards the outlet, accompanied by loss of power necessary to transport the material with which it is loaded. The excess of load is dropped in the bed, decreasing the section below the outlet. When these conditions occur frequently * * * the injury inflicted on the river as a channel or as a drain is cumulative, leading to general deterioration."

All later observations have confirmed these conclusions and nothing has been developed which seriously questions their validity.

In 1913 the commission directed that surveys be made of possible spillway sites below Baton Rouge and after consideration of the results, reached the following conclusions, in November, 1914: "Exhaustive surveys and examinations have been made of six possible sites for spillways below Baton Rouge, and while such spillways of adequate dimensions might reduce flood heights locally to a limited extent, their introduction into the adopted scheme of flood control would add new and serious dangers to the integrity of the levees themselves, and to the lands and improvements in the vicinity of the controlling works. Then too the first cost and the maintenance of such controlling works would be very great and far in excess of the benefits that might be derived therefrom. It is therefore the opinion of the commission that the use of spillways for the purpose of reducing flood heights is impracticable."

The writer has not deemed it necessary to burden these statements with definite figures as they are to be found in abundance in the reports and files of the commission.

J. A. OCKERSON,
Past President, American Society of Civil Engineers.

St. Louis, Mo., Jan. 25.

[The two letters above were referred to Col. Townsend, who has replied as follows:—EDITOR.]

Sir—The letters of Mr. Ockerson and Mr. Kemper instead of refuting the deductions in my paper on spillways, merely confirm them.

A reduction in carrying capacity of 7 per cent to 24 per cent as stated by Mr. Ockerson would be detrimental to navigation between Cairo and the mouth of the Red River where channel depths varying from 4½ to 10 ft. are found on bars at lower water, but below New Orleans, where depths exceeding 60 ft. exist on crossings, a reduction to 50 ft. would be of no practical importance to seagoing vessels so long as the depth on the bar at the mouth of the river does not exceed the 35 ft. of the existing project.

Mr. Kemper relies on the resistance afforded by four miles of "stumps and vegetation," to prevent a concentrated flow of 250 000 sec.-ft. on a slope of four feet to the mile, from scouring Louisiana alluvium after "something of a hole has been dug" at the weir. Those "who built the Panama Canal, the Keokuk dam and the Roosevelt dam" used larger coefficients of safety.

Mr. Kemper utilizes a typographical error to controvert my computations of flood heights. The crest of the flood culminated at Vicksburg on April 28 instead of April 18 erroneously stated in the paper. This could have been inferred from the allusion to the propagation of the flood to the mouth of Red River in 17 days. Even the hydrographs published by the committee show two distinct flood waves down to Donaldsonville.

C. McD. TOWNSEND,
Col. (ret'd), Corps of Engineers, U. S. A.

Brooklyn, N. Y.
Feb. 7, 1923.

A $15,000 Water Bond Issue Will Cost City $39,750

Sir—The $15,000 of water improvement bonds issued in 1892 by Mt. Pleasant, Mich., will cost the city of Mt. Pleasant $39,750. This is a condition that one might find in a good many other cities in the United States. Long-term bonds have been quite generally used in the past, but improved city finance make use of serial bonds.

The Mount Pleasant water bonds of 1892 were to run for fifteen years and bear 5 per cent interest. No sinking fund was provided. When the bonds were due in 1907 there was no money available to retire them. To raise the whole $15,000 by taxation in one year when the entire tax would otherwise be only $17,400 was out of the question. So the $15,000 bond issue was refunded for twenty years, but at 4½ instead of the original 5 per cent.

Not a dollar was put into a sinking fund to relieve this bond until June 1922, when $2,500 was appropriated by the commission and it was recommended that the same amount should be appropriated yearly for the next five years, so as to retire these bonds on July 15, 1927.

Interest on the original bonds for fifteen years at 5 per cent was $11,250 and on the re-issue for twenty years at 4½ per cent is $13,500, making a total of $24,750 interest. If 5 per cent 1-15-year serial bonds has been issued the total interest charge would have been $6,000 instead of $24,750 or a saving of $18,750. This is not all, for the water-works bond issue is only one of several of the sort that this city has had to shoulder. We are now paying city debts that should have been paid fifteen years ago. No wonder that taxes are high.

C. H. PETERSON,
City Manager.

Mt. Pleasant, Mich., Feb. 7.

River Improvement Costs on Ton-Mile Basis

In a special report now before the Joint Waterways Committee of the Western Society of Engineers the following estimates are offered as to the costs of several river improvements reduced to a ton-mile basis. The figures are not to be considered accurate but are submitted as approximations or indications of actual costs:

Waterway:	Ton-Miles Per Year (Millions)	Total Annual Cost (Includes Annual Maintenance Plus 5 Per Cent of First Cost)	Cost of Improvement Per Ton-Mile Per Year Including Maintenance
Monongahela	782	$1,700,000	$ .00216
Ohio	4,220	4,500,000	.0011
Mississippi (Vicksburg to New Orleans)	750	1,600,000	.00215
Allegheny	10.2	288,000	.015
Sacramento	96	132,750	.00138
Warrior System	173	775,000	.00447
Mississippi (Mouth of Missouri to Cairo)	175	989,000	.00565
Total	6,209	10,084,750	.00162

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevitics

An injunction suit against a bond issue of $2,000,000 for municipal improvements at Beaumont, Tex., authorized two years ago, has been dismissed by the Texas Supreme Court. It is expected that steps will be taken at once to expend the money for municipal improvements.

By the terms of a law passed recently by the Government of Panama a loan of $4,500,000 is to be floated so that the national program of highway construction started in 1921 may be carried on. R. W. Hebard & Co., Inc., of New York and Panama, are the engineers and contractors for work.

On Feb. 27 Champaign County, Ill., is to vote on a bond issue for $2,500,000, the proceeds of which will go to the building of hard surfaced roads. The system is approved by the State Highway Department and comprises 173 miles of 9-ft. concrete road which can be widened to an 18-ft. width as traffic demands.

The senate committee on education and labor has reported favorably and without amendment the Frelinghuysen bill to create a commission on unemployment to study public works which may be undertaken advantageously in periods of depression when abnormal numbers of men are without work.

The East Jersey Water Co., a corporation interested in the water supplies of various New Jersey cities and towns, has been declared a public utility and thus subject to state regulation by the New Jersey Court of Errors and Appeals. The decision has a bearing upon a number of controverted water-supply and rate questions in northern New Jersey.

An engineering committee to report on the design of the army semi-rigid dirigible RS1 has been named by the National Advisory Committee for Aeronautics. It consists of Henry Goldmark, chairman; W. W. Pagon, Prof. Wm. Hovgaard, Dr. L. B. Tuckerman, and Dr. Max Munk. The first meeting is to be held Feb. 23. A committee of the same membership was appointed last summer to investigate the naval rigid airship built at Lakehurst, and recently reported.

Hearings on the application of the New York Port Authority to require the railroads entering the port to cooperate with it in the carrying out of its comprehensive plan has been set by the Interstate Commerce Commission for March 15. It will be held at the office of the Port Authority, 11 Broadway, New York City, concurrently with a hearing on the same subject to be held by the Port of New York Authority.

Fire in New York Hospital for Insane Cost 25 Lives

Twenty-two patients and three attendants were burned to death in a fire which destroyed the west wing of the east main building of the Manhattan State Hospital for the Insane on Ward's Island, New York City, early Sunday morning. The fire occurred in the hospital wing of one of the buildings which was erected more than half a century ago, and which had not been made fireproof. Due to the fact that during the early part of the fire only the hospital's own fighting equipment—two steamers, one truck, one utility wagon and one horse-drawn hose cart—was available, damage to life and property was doubtless greater than it otherwise would have been.

The fire started around five o'clock and was not out until six hours later. As soon as the gravity of the situation was realized alarms brought to the East River from New York apparatus, but only two pieces of apparatus even then were ferried over. To the island's equipment working through a 12-in. pressure main, were added two of the New York fireboats, which, however, before they could operate, had to stretch lines of hose 1,500 ft.

The fire of Sunday is the sixth that has occurred at the island in the past 26 years. Each time emphasis has been placed by the press upon the lack of fire fighting equipment at the institution.

Several investigations have been ordered. Governor Smith, of New York, has deputized Dr. Floyd C. Haviland, head of the state hospital commission, to represent him in the state investigation.

Consider Electrification for Ontario Railway

A report recommending electrification of the Timiskaming & Northern Ontario Ry. by F. B. Clement, chief engineer, and J. G. G. Kerry, consulting engineer of the T. & N. O. Ry., is now under consideration by the commission operating the line and the Ontario government. Electrification is recommended for the main line from North Bay to Cochrane, a distance of 252.3 miles; for the Iroquois Falls subdivision, 17 miles; and for the Porcupine subdivision, 33 miles, the commission to take immediate steps to secure control of water power on the Amable du Fond, Blanche and Frederickhouse rivers. It is also recommended that opportunities be given to companies operating power plants in the district to bid for the supply of electric power. The estimated cost of electrifying the line to give it capacity to handle the traffic expected by 1925, estimated at 25 per cent greater than that handled in 1921, is $11,814,778. The T. & N. O. commission, in presenting the report to the provincial government, recommended that electrification be postponed for the present, as its success will depend upon the volume of future traffic.

Harding Submits Government Reorganization Plan

Interior Department To Control Public Works Construction and Maintenance

Co-ordination of the military and naval establishments under a single cabinet officer, transfer of all non-military functions from the War and Navy Departments to civilian departments, elimination of all non-fiscal functions from the Treasury Department, establishment of one new cabinet office, renaming the Post Office Department the Department of Communications, and the attachment to the several departments of all independent establishments except those performing quasi-judicial functions or acting as service agencies for all departments, are main recommendations made by President Harding and the cabinet in the reorganization plan sent to the Joint Committee on Reorganization of Government Departments last week.

Of chief engineering interest is the inclusion in one department—Department of Interior—of principal agencies for the construction and maintenance of public works. The Department of Interior is given, under the reorganization plan, but two major functions: the administration of the public domain and of the construction and maintenance of public works. An assistant secretary is provided for to perform each of these two functions. Under the assistant secretary for public domain would be administration of Hawaii and Alaska, Indian lands and reservations, the General Land Office, War Minerals Relief Commission, the Geological Survey, National Park Service, National Military Park Commissions (transferred from the War Department) and the Federal Power Section, which would include the Federal Power Commission.

The assistant secretary for public works would have jurisdiction over the following: Bureau of Public Roads (which is transferred from the Department of Agriculture), the Supervising Architects Office from the Treasury Department), the Alaskan Engineering Commission, the Reclamation Service, the Board of Engineers for Rivers and Harbors (from the War Department), the Board of Road Commissioners for Alaska (from the War Department), and the Bureau of District of Columbia Building and Grounds.

The Board of Engineers for Rivers and Harbors would contain the following bodies: Board of Engineers, New York City; U. S. Engineer offices; the Mississippi River Commission and the California Debris Commission. These are now in the War Department.

The Bureau of District of Columbia Buildings and Grounds would contain: Office of Public Buildings and Grounds, the Commission of Fine Arts, the Superintendent of State, War and Navy Buildings, the architect of the Capitol and the Rock Creek and Potomac Parkway Commission.

The new government department recommended in the President's plan would be called the Department of Education and Welfare. An assistant secretary in this new department would be charged with administration of various agencies concerned with public health. The public health bureau would therefore be transferred from the Treasury Department, and with hospitalization included in the enlarged bureau, several hospitals now under the War and Interior Departments would be transferred thereto.

COMMERCE REORGANIZATION

Under the reorganization plan the Department of Commerce is given three major functions: the promotion of industry; the promotion of trade; and the development, regulation and protection of the merchant marine. The subdivisions are accordingly organized under three assistant secretaries. Under this plan the Bureau of Patents would be transferred from the War Department and given to the assistant secretary for industry, as would the Bureau of Mines, transferred from the Interior Department, and the Bureau of Standards, already included in the Department of Commerce. A new bureau—that of transportation — would be created to be supervised by the assistant secretary for trade in the Department of Commerce. This would include supervision over airways, waterways (federal canals except Panama), and highways. To the third of the three assistant secretaries in the Department of Commerce would be given supervision over the merchant marine, and to his department would be transferred: from the War Department, the Lake Survey, and from the Navy Department the Hydrographic Office, both to be included in the Coast and Geodetic Survey; and from the War Department Inland and Coastwise Waterways Service and the supervisor for New York harbor. Bureaus now in the Department of Commerce which the assistant secretary for merchant marine would supervise include the Bureau of Lighthouses and the Bureau of Navigation.

The Forest Service over which there has been considerable discussion, remains in the Department of Agriculture.

INDEPENDENT ESTABLISHMENTS

In the President's reorganization plan existing independent establishments have been placed under the supervision of some department, insofar as has been deemed expedient. Only those remain as independent organization which are quasi-judicial in character. These include: Civil Service Commission, Shipping Board with the Emergency Fleet Corp., Tariff Commission, Interstate Commerce Commission, Federal Trade Commission, Federal Reserve Board, War Finance Corp., Coal Commission, Railroad Administration, Railroad Labor Board, World War Foreign Debt Commission, Bureau of the Budget, the Government Printing Office, Bureau of Efficiency, and the Bureau of Purchase and Supply.

In transmitting his recommended reorganization plan the President asserted that in a few instances, "believed to be of minor importance, the principle of major purpose was not followed out to the letter, in order to avoid controversies which might jeopardize reorganization as a whole."

Albany Society Adopt Resolutions on State Engineer

At a recent annual meeting of the Albany Society of Engineers a resolution was adopted approving the principle of a proposed amendment to the constitution of New York State authorizing the consolidation of the offices of state engineer and surveyor and superintendent of public works but disapproving the amendment in its present form or in any other form that does not provide that the holder of the new office having "control of engineering works shall be an engineer of not less than fifteen years' experience and training in engineering work." A copy of the resolution may be secured from John W. Henry, secretary, 89 Morris St., Albany, N. Y.

A year ago, Governor Miller said in his annual message that economy would result from the consolidation of the two offices named above, possibly including also the departments of highways, buildings and state architect. The legislature of 1922 adopted a concurrent resolution (which if passed by the 1923 legislature and endorsed by a state-wide referendum vote would become a constitutional amendment) authorizing legislation, which, in effect, would consolidate the offices of state engineer and of superintendent of works (see *Engineering News-Record*, April 6, 1922, p. 584.)

Governor Smith, in his inaugural message as successor to Governor Miller (a message delivered after the action of the Albany Society of Engineers, already cited), recommended more sweeping action along the lines of a plan worked out in 1920 for consolidation of state administrative departments that would reduce the number of these from 180 to 19. Pending the final passage of the constitutional amendments Governor Smith advises the legislature to make such consolidations as can be effected by statute. These consolidations, which are to be outlined in a special message, would enlarge the powers of the present Departments of Conservation, Health, Education, Farms and Markets and Adjutant General.

Road Oiling in Illinois Calls for $2,000,000 Expenditure

Results of a summation made by the Illinois state highway department shows that oiling of roads has become an industry second only in importance to the construction of hard roads in that state. The oiling programs by the various counties have called for an expenditure of over $2,000,000 for 1922, approximately $1,500,000 for 1921 and indications are that the expenditures will be materially increased during 1923. The laboratory inspected over 35,000,000 gal. of oil during 1922—3,000,000 gal. for one county alone.

The laboratory made many field inspections which brought out the following considerations: "The first requisite to a good job of oiling is a road surface free from pits, ruts and dust. There was noticed a tendency to spread the oil over too great a mileage in two ways—first by oiling a narrow strip in the center of the road and second by using thin oil having low viscosity and low asphaltic content. Either of these practices defeats the purpose of oiling."

Committee to Study Pollution of Curtis Bay, Baltimore

A committee to study the pollution of Curtis Bay, Baltimore Harbor, has been appointed by Dr. John S. Fulton, director, Maryland Board of Health, as follows: Dr. M. C. Whitaker, vice-president of the United States Industrial Alcohol Co.; E. B. Miller, vice-president of the Davison Chemical Co.; Dr. Wade H. Frost, professor of epidemiology, School of Hygiene and Public Health, Johns Hopkins University; Abel Wolman, chief engineer of the State Department of Health, and Swepson Earle, of the State Conservation Commission. Industrial wastes seem to be the chief source of trouble and to be threatening fish life and the steel and wood of ships. The dissolved oxygen parts of the area has fallen from 19 per cent of normal in 1915 to zero at present, according to Mr. Wolman.

Gift of $4,200,000 to California Institute of Technology

The Board of Trustees of the California Institute of Technology at Pasadena, Calif., have announced an additional gift from Arthur H. Fleming, amounting to $4,200,000, which is to be kept intact as a perpetual trust fund and the income from which is to be used for endowment uses and research purposes.

In presenting the gift the donor made certain recommendations as to the future policy of the Institute. He suggested that the enrollment be limited to 2,000 students, that the present engineering work be continued, and special attention be given to research in chemistry and physics, and that endeavor be made to invite the superior student and help encourage those disposed to research.

Denver to Vote Again in Spring Election for Water Bonds

At the regular May election in Denver, Colo., a charter amendment will be voted upon providing for the issuance of about $7,000,000 water-works improvements bonds, as recommended by the Engineering Board of Review. In a bulletin issued Feb. 1 by the Board of Water Commissioners the statement is made that it is not possible to delay the beginning of construction beyond the summer of 1923 as work on all units must proceed together—conduit system, filters, distribution system and enlarged pumping plants.

Because of urgent necessity for more water this season expenditures from current revenues have been authorized which will give three of the pumping stations an additional capacity of 10,000,000 gal.

Following the war water was furnished free for thrift-gardens. During the season of 1922 so much water was wasted that the board has decided that no free water will be furnished this year. Another saving measure will be the restriction of the irrigation of lawns to four days per week. Properties bearing even numbers may irrigate on Mondays, Wednesdays and Fridays and Sundays, while those having odd numbers may use water the other days in the week.

Indiana Sanitarians Discuss Water, Sewage and Fire

Fire prevention, water-works operating difficulties, softening problems and the relation of sewage to water at the lower end of Lake Michigan were the main topics discussed Feb. 14 and 15 at Indianapolis, at the Annual Meeting of the Indiana Water Supply and Sanitary Association. About 125 sanitary engineers, water-works operators and health officials registered.

Frank C. Jordan, secretary, Indianapolis Water Co., has been assisting the local fire officials in a campaign of fire prevention in the city and now proposed to make the co-operation and educational features state wide giving service outside the city limits, which is made possible because of the increasing network of good roads. The nucleus of a state fire protection association has been formed whose aim is to effect better co-operation between water and fire departments.

Charles P. Hoover, chemist in charge of the water purification plant at Columbus, Ohio, in discussing water softening, stated that water was so much cheaper than gas, electricity and local transportation that the public would soon demand water in Middle West states be brought down to approximately 100 p.p.m. of hardness. Time and temperature factors in chemical reactions are far more important than they have been credited with. In the Columbus mixing tanks where the water remains only 2 hours 90 per cent of the work is done, only 3 per cent is done in the 15 hours in the settling basins and 7 per cent in the filters. He deduced that large basins are unnecessary and described a carbonator costing $900 per million gallons which will do much of the same work. In answering Mr. Hoover's contention that hard waters like the Indianapolis supply would soon require softening, H. E. Jordan of the local company stated there were several needs preceding a softening program that the public were clamoring for.

Selling water to contractors by meter is the best practice according to a round-table discussion on the subject, though few cities do it that way, thereby incurring much difficulty with flat rate wasters and yearly permits because of fly-by-the-night contractors who failed to pay for water used.

L. R. Howson, consulting engineer, Chicago, repeated the startling effects of water waste in Chicago given at the Midwinter Convocation of the Western Society of Engineers. Paul Hansen, consulting engineer, Chicago, gave a history of the Bloomington (Ind.) water situation, on the solution of which several consulting engineers are in substantial agreement but which the officials as often have rejected, until last year water had to be hauled into the town by train at price of $1 a barrel.

A committee on rules and standards of service for water utilities reporting to the State Public Service Commission has prepared a set of rules and standards more elaborate than yet adopted by any of the states. Carl Wilde, secretary of the committee, discussed those referring to water. The reports will be sent to members as well as to the commission.

Officers elected for the ensuing year are as follows: H. E. Jordan, president; C. K. Calvert, secretary-treasurer.

Syracuse Leases Its Garbage Works for Five Years

A five-year contract for the disposal of the garbage of Syracuse, N. Y., by means of the garbage-reduction works owned by the city, has been let to the C. O. Bartlett & Snow Co., Cleveland, Ohio. The company will install additional machinery at a cost to itself of $35,000. The city will deliver the garbage to the plant and will pay the company $30,000 a year for its services.

The garbage-reduction plant, which is of the Cobwell type, was installed by the company named. It was put in operation March 1, 1921. On Jan. 1, following, the city administration changed and there were soon allegations against the way the plant had been operated by the preceding administration, besides complaints of an excessive net operating cost and claims of a reduction of the net cost under the new administration. Soon after the middle of the year the city invited bids for the disposal of its garbage. Among the resulting offers was one from the C. O. Bartlett & Snow Co., substantially as outlined above. The mayor advised acceptance of this bid but the council voted against it. On Dec. 10 the plant was shut down on the ground of the high cost of operation and burial of the garbage begun (see *Engineering News-Record*, Jan. 11, p. 89). Finally the council approved the lease already outlined, but owing to illness in the legal department the contract had not been executed up to Feb. 16.

It is expected that the plant will be taken over under the contract by March 1, but that the additional equipment will not be installed and the plant in full working order until two or three months later.

I.C.C. Approves Southern Pacific Control of Central Pacific

The Interstate Commerce Commission has approved the acquisition by the Southern Pacific Co. of control of the Central Pacific Ry. by stock purchase and by lease. The order authorizing this step provides conditions designed to prevent discrimination against the Ogden route and to permit other disposition of the Central Pacific should the commission find it desirable in carrying out its consolidation program.

Michigan Road and Bridge Builders Organize

Organization of the Michigan Road Contractors Association composed of road and bridge contractors operating throughout the state was effected at a dinner meeting held recently. Practically all contractors present became charter members. The temporary officers who were appointed at a preliminary meeting held in Grand Rapids in November were made permanent. The officers are: President, L. D. Townsend, Lansing; William H. Ryan, Jackson, vice-president; C. A. Handyside, Detroit, treasurer.

The association will lend its energies to encouraging and promoting public highway improvement and harmonizing the interests of the contractor, the public, and public departments. The headquarters of the association have been established in the Capital National Bank Building, Lansing, Mich.

Congress Inaction Hampers Coal Commission

Legislative Zeal Wanes with Passing of Emergency—Necessary Bills Go Over from Week to Week

Washington Correspondence

Congress has failed to hold up the hands of the coal commission which it created. Because of its dilatoriness, the services of Judge Alschuler, one of the commission's most valuable members, were lost. Early in its term, the commission asked also for legislation to make compulsory and provide penalties covering the returns submitted on questionnaires. As this is written, there still is much uncertainty as to when that legislation will be forthcoming. It still remains to be seen whether or not the same policy will prevail in the handling of the legislation carrying $400,000 for the expenses of administering the commission.

Commission Handicapped

The procrastination and the lack of interest on the part of Congress is handicapping the commission in its work and lessening its possibilities for usefulness. The attitude of the legislative bodies toward the coal commission can not be attributed to any displeasure with the work the commission has done. On the contrary, opinion on Capitol Hill is generally favorable to the commission. When the commission bill was passed, the country was face to face with an emergency with coal. Public opinion was inflamed. Under those conditions, Congress was prompt to pass the bill and apply the counter irritant. In the meantime, the emergency has passed. The strike danger has been postponed for a year. The price of coal is falling and the full requirements of the country are in a fair way to be met. Public interest no longer is focussed on coal. As a result, the legislation held to be necessary to the commission's maximum accomplishment goes over from day to day and week to week. Even Chairman Winslow, of the Committee on Interstate and Foreign Commerce, coming as he does from New England where the fuel situation has been most acute, ranks the coal bill as eighth in importance among the measures that his committee will bring before the House. When his committee has its day, under House rules, seven other pieces of legislation must be disposed of before the coal bill is laid before the House.

Stock Report Figures

The stock report, issued under the authority of the federal fuel distributor, showing only 36,000,000 tons of coal in storage on Jan. 1, reveals how unprepared the country would have been to withstand a strike this year. With stocks at that level and with demand much increased over that of a year ago, it is apparent that the country could not have built up stocks to equal those of April 1, 1922, when 63,000,000 tons were in storage. The stock report explains clearly why prices are 50 per cent higher than they were about a year ago.

The increase in the demand, however, cannot be attributed entirely to enlarged industrial activity, since no small portion of this demand is for the purpose of replacing anthracite.

Indiana City Planning Engineers Hold Conference

City planning engineers of Indiana in a conference Feb. 14 and 15 at Lafayette, under the auspices of the civil engineering department of Purdue University, held a conference on city planning programs and legislation. Attorneys, members of city plan commissions, real estate operators, as well as engineers were in attendance. R. H. Whitten, city planning engineer for Cleveland, spoke on "Zoning Problems." Harland Bartholomew, St. Louis, and Prof. L. S. Smith, University of Wisconsin, were also on the program for the engineers.

Allegheny River Bridge Not to Have Stone-Faced Piers

On Feb. 6 the county commissioners of Allegheny County (Pittsburgh), Pa. (V. R. Covell, county engineer), awarded a contract for the construction of the piers of the new 40th St. bridge over the Allegheny River between Pittsburgh and the Borough of Millvale to H. P. Converse & Co. for $854,692. The contract is for concrete piers carried to rock, without stone facing. The award ends an active controversy as between concrete and stone-faced piers. Alternate designs were submitted by the architect and engineer, Benno Janssen and C. S. Davis, with the recommendation that stone facing be used. The low bids on the two types of construction were $600,000 higher for the stone-faced piers. The stone facing was urged because of the likelihood of surface deterioration of the concrete, and action of acid river water upon it. The difference of cost was affected by the fact that the arcaded piers of the long approach on the Pittsburgh side are relatively thin and in the stone-faced designed were therefore planned to be of stone throughout (without concrete core), and the fact that they are skewed and would therefore involve relatively high stonecutting costs.

Canadian Land Surveyors Hold Annual Meeting

The practical value of the tabulated information gathered by land classification surveys in solving the problems confronting land settlement; the extension of topographic mapping in Canada; the vast mineral resources of the western provinces, and the operations of the Geodetic Survey of Canada, were among the matters discussed at the sixteenth annual meeting of the Dominion Land Surveyors' Association in Ottawa, Ontario, recently. Delegates were in attendance from every part of the Dominion. Major Douglas H. Nelles of Ottawa was elected president for the ensuing year.

In his annual report the retiring president, C. H. Herriott, stressed the fact that since 1918 not less than 20,500,000 acres of land had been examined and classified as to suitability for settlement, and reconnaissance made of 8,117,000 acres, as a preliminary to a more detailed examination.

How the federal government, through the agency of detail maps prepared by the Geological Survey of Canada, was making the work of the prospector much less difficult, than in the past, was explained in a paper by F. J. Alcock.

Indiana Court Orders License Issued to Practising Engineer

By a county court decision in Marion Co., Ind., the Board of Engineering Examiners has been mandamused to issue a license to an engineer practising professional engineering within the state for a year or more and complying with the other requirements of the engineer's license laws. The ruling held that the board had no discretionary powers to construe the law as meaning that the applicant for a license should have been in responsible charge of work, this being the defense of the board. On this point the judge ruled as follows:

"While I may commend the motives of the defendant board and approve the standard of efficiency they are endeavoring to set in this case, I am constrained to feel that no matter how laudable their motives may be, and no matter what their conception concerning their duty to a public trust might be, they cannot enlarge or restrict the plain and clear meaning of the language used by the legislature."

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Association of Professional Engineers of Manitoba held its annual meeting in Winnipeg Jan. 18 and elected as president, Alexander Young; vice-president, E. V. Caton; registrar, George L. Guy.

The Northeastern Section of the American Society of Civil Engineers held its annual meeting Jan. 27 in Boston. The officers elected for 1923 are: chairman, Lewis E. Moore; vice-chairman, Arthur D. Weston; secretary-treasurer, Charles W. Banks.

The Engineers' Club of Minneapolis has elected as its new president Prof. W. T. Ryan of the department of electrical engineering of the University of Minnesota; and as secretary A. F. Mellen, assistant superintendent of the Minneapolis filtration plant.

The Illinois Section, American Society of Civil Engineers, Jan. 4 at its annual meeting elected H. R. Safford, vice-president, Chicago, Burlington & Quincy R.R., as president, and C. B. Ball, chief sanitary inspector, City of Chicago, as vice-president for the coming year. An invitation was given to the parent society to hold the summer meeting (June) in Chicago. All of the fifty members present contributed to the $150 quota of the Illinois Section for the balance necessary to insure the erection of a bust over the tablet of James Buchanan Eads in the Hall of Fame.

The Associated Engineers of Spokane, Wash., at their recent annual meeting elected J. C. Carpenter, mechanical engineer, as president and A. D. Butler, city engineer, as secretary and treasurer. Vice-presidents and members of the executive committee were also elected.

The Highway Engineers' Association of Missouri at its recent annual meeting at Columbia, Mo., elected as president F. B. Newton, division engineer of the state highway department; as vice-president, J. W. Wilson, county engineer of Johnson County; and re-elected as secretary and treasurer Carl W. Brown, assistant state engineer.

The Illinois Section of the American Water Works Association will hold its annual meeting March 21 and 22 at Decatur. Subjects scheduled are impounded water supplies, softening, financing public utilities, customer ownership, increased use of water, supervision of filters, consolidation of small plants, the fuel problem and the advisability of small utilities owning or controlling coal mines.

Personal Notes

H. R. DAVENPORT, until recently assistant engineer with the Mountain Water Supply Co., has become associated with the Missouri State Highway Commission as a designer in the bridge department.

O. H. STREHLOW, construction engineer with James O. Heyworth, Chicago, has been made a member of the firm of Walsh & Masterson, contractors, succeeding Herbert S. Walsh, who recently died. Mr. Strehlow, a graduate civil engineer of the University of Illinois, has had wide experience in general engineering and has had special training in river and harbor work.

J. L. STANNARD, formerly with Grant Smith & Co., contractors, of San Francisco and elsewhere, has been appointed chief engineer of the Lake Cushman power project which is being undertaken by the City of Tacoma, Wash.

CHARLES W. STANIFORD was appointed consulting engineer on the construction of the Wilmington marine terminal, now nearing completion, at a recent meeting of Board of Harbor Commissioners, Wilmington, Del. Mr. Staniford has for the past year and a half been associated with the late B. F. Cresson, Jr., consulting engineer.

HON. E. H. ARMSTRONG, minister of public works in Nova Scotia since 1911, has been appointed premier of the province of Nova Scotia.

D. C. MORROW, for 11 years borough engineer of Washington, Pa., will resign this position to become superintendent of the Citizens' Water Co. of that city. Mr. Morrow has had charge of construction of numerous sewer extensions, new paving, a garbage incinerating plant and sewage purification works.

JAMES H. GRIER is now superintendent of construction for Siems, Helmers & Shaffner, general contractors of St. Paul, Minn. Mr. Grier was formerly connected with the Michie Construction Co. as construction superintendent.

GEORGE F. KIDD, designer and constructor of power plants, mills and factories, of East Orange, N. J., has recently become eligible to appointment as assistant bridge engineer of the New Jersey State Highway Department. Mr. Kidd finished first in a recent civil service examination held for the position.

WILLIAM J. ROBERTS, of Tacoma, Wash, has resigned as chief engineer of the Intercounty River Improvement, a flood control project comprising channel changes in the White-Stuck and Puyallup Rivers, costing about $1,900,000. HAMILTON F. GRONEN, formerly commissioner of light and water, of Tacoma, has been appointed chief engineer of the project.

A. B. ROBERTS, who has been director of public utilities for the City of Cleveland for the past thirteen months, has resumed his position as vice-president of the Withington-Roberts-Wright Co., consulting engineers, Cleveland, Ohio. During the war Mr. Roberts was in charge of the designing and construction of the Aberdeen Proving Ground, Maryland, with the rank of major under Col. W. A. Phillips. He is a director of the Cleveland Engineering Society.

CAPT. F. A. MCCOMBER has been appointed assistant city engineer of Duluth, Minn., to succeed A. U. SHIPMAN, who has retired to enter business in Duluth as a contractor. Capt. McComber is president of the Duluth branch of the Society of American Military Engineers. He was for several years employed in the Duluth city engineer's office.

LUPFER & REMICK, consulting and contracting engineers of Buffalo, New York, was dissolved on Feb. 1, upon the withdrawal of Mr. Remick from the firm. Mr. Lupfer has organized the Edward P. Lupfer Corp., with offices in the Ellicott Square, Buffalo, and has associated A. J. Dillenbeck with him.

DAVID A. WATT has joined the staff of the Roger Black Company, Inc., engineering and construction, New York City, to take charge of the company's engineering work. Mr. Watt has been engaged in bridge and building work, and on lock and dam construction in different parts of the country for many years. The latter work was done under the Corps of Engineers, U. S. Army. As major of Engineers during the war Mr. Watt was placed in charge of the Wilson Dam, at Muscle Shoals, where he laid out a complete construction plant and carried on the general construction until the completion of the first cofferdam, turning the work over at that time to Col. J. B. Cavanaugh, Corps of Engineers, and remaining as assistant engineer until Hugh L. Cooper & Co. became consulting engineers for the project, when he joined Colonel Cooper's field staff.

J. W. PAXTON, has tendered his resignation to Director Caven as assistant engineer of the Division of Street Cleaning, Philadelphia, which position he has held since November 1, 1921. Mr. Paxton's resignation is made necessary by ill-health.

H. W. FLEMING, assistant engineer, stationed at Ottawa, has been appointed district engineer, Nipigon Division, of the Canadian National Ry., with headquarters at Hornepagne, Ont.

T. B. BALLANTYNE, division engineer, stationed at Schreiber, Ont., has been appointed division engineer of the Farnham Division of the Canadian Pacific R.R. His office is at Farnham, Quebec. M. KELLY, division engineer of the Farnham Division, has been appointed division engineer of the Toronto terminals, with headquarters at Toronto.

HERBERT NUNN, for the past several years state highway engineer of Oregon, has tendered his resignation to the highway commission. Though the resignation was handed in some time ago to become effective Feb. 6, the commission as yet has taken no action.

A. T. NORTH, engineer and architect of Chicago, has accepted a position as engineering editor of the *American Architect*. Mr. North has had a wide engineering and construction experience in various parts of the country. He is a former chief engineer of the National Fireproofing Co. (Western department) of Chicago, contracting engineer with Wells Bros. Construction Co. of Chicago, and consulting engineer for the Yellow Pine Manufacturers Association, also of Chicago.

ERNEST MCCULLOUGH, associate editor of the *American Architect*, has resigned to become associated with Dwight P. Robinson & Co., New York, in their engineering department. Mr. McCullough, prior to his connection with the *American Architect*, was in the army. He spent twenty-seven months in France, first in charge of construction work for the American Red Cross and later with the Chemical Warfare Service. Besides having done consulting work in various parts of the country, he has contributed much to technical literature and has had rather a wide experience in technical journalism.

JAMES A. FRENCH has been appointed state engineer of New Mexico, his appointment to become effective March 1. He replaces Charles A. May, the present incumbent. Mr. French's early professional experience was gained in the U. S. Coast and Geodetic Survey and with the Union Pacific and the Chicago, Burlington & Quincy Rys. Later he was employed in the engineering department of the District of Columbia and still later as an assistant engineer in the U. S. Reclamation Service. During that latter employment he was identified with the construction of the Shoshone dam outlet tunnel, and on the Sun River project, in Montana. He was also engineer-in-charge for the Reclamation Service of the Rio Grande project, New Mexico and Texas. Mr. French is a resident of santa Fe and held the office of state engineer under a previous administration.

W. J. CORBITT has been engaged as industrial engineer to be associated with R. A. Bull, research director, in the increased activities of the Electric Steel Founders Research Group.

FRANK A. RANDALL, consulting engineer, formerly of Berlin, Swern & Randall, announces that he will continue the independent practice of structural engineering at the address of the former company, 19 South La Salle St., Chicago.

W. H. WARNOCK has been appointed, effective Feb. 19, town engineer of Montclair, N. J., succeeding William F. Bates, who died Jan. 10. Mr. Warnock is a graduate of the Massachusetts Institute of Technology, class of 1905, and after about a year of service with the Holyoke (Mass.) Water Power Co. and with Westinghouse, Church, Kerr & Co., on the construction of the Pennsylvania railway terminal in New York City, he joined the engineering staff of the New York Board of Water Supply, which was then beginning the construction of the Catskill Aqueduct As assistant engineer and later as section engineer in charge of a portion of the 18-mile city tunnel in Manhattan he remained on the Catskill work eleven years. In 1917 he was engaged on investigation and research with the New York City Bureau of Fire Prevention until the United States entered the war, when he was commissioned captain in the Construction Division of the Army, serving as field officer at Camp Stuart, Newport News, Va., and later as construction quartermaster and disbursing officer at Lee Hall, Va., where the army was constructing an additional water supply system for Newport News. Prior to his present connection Mr. Warnock was engaged, for a time, on industrial development investigations for Cross & Brown, real estate operators of New York City.

Obituary

THOMAS W. COTHRAN, prominent in civil engineering and construction circles in Greenwood, S. C., for the past fifteen years, died at his home in that city Feb. 9. Previous to his entering private engineering practice he had been principal assistant engineer of the South & Western Ry., now the Carolina, Clinchfield & Ohio. Prior to that time he was assistant engineer in the chief engineer's office of the Seaboard Air Line Ry. He was a member of the first graduating class of Clemson College, S. C., and for a time was an instructor in that institution. Later he was with the U. S. Geological Survey.

EDWARD J. FARRELL, retired construction engineer and tunnel builder, died Feb. 13 at his home in New York City, aged 72 years. He was born in Capagne, New Brunswick, Canada, and educated there. He was a member of the Am. Soc. C. E. Some of his earlier construction work was on the Hoosack tunnel from North Adams to Springfield, Mass.; and the Lacine canal in Canada. He also worked on the old Croton Aqueduct, the Lenox Avenue Subway from 135th St. to the yards at 155th St., Sections 7 and 8 of the B. R. T. from 104th St. and Broadway under Central Park to 113th St. and Lenox Avenue. The last big job in which Mr. Farrell was interested was the construction of the New York Speedway running from 155th St. to Dyckman St. along the Harlem River.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

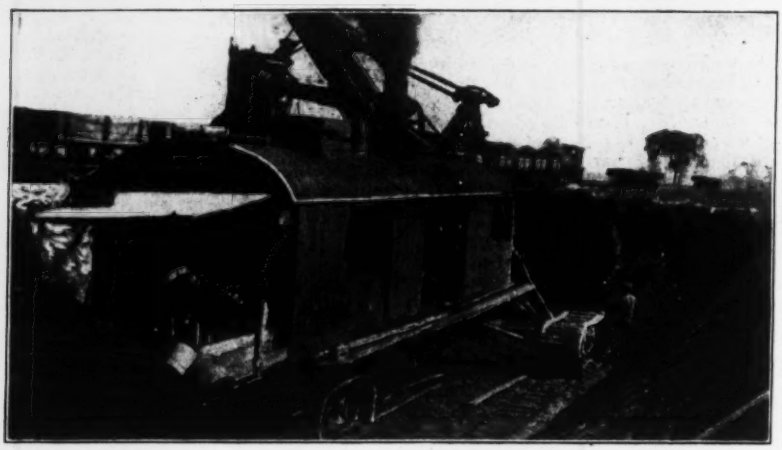
Crawler Mountings for Railroad-Type Power Shovels

Operating Economies Made Possible by Recent Change in Design—Use Extending to Many Fields

By Bradlee Van Brunt
Bucyrus Co., South Milwaukee, Wis.

TIME honored methods of steam-shovel operation are undergoing radical revision as the result of the introduction last year of crawler mountings for the large, railroad-type shovels. Translated into terms of operation, this innovation eliminates the necessity of hifting track sections, releasing jacks, setting rail clamps, and resetting the acks after the shovel has been moved up preparatory to the resumption of ligging. The first set of crawlers under a railroad-type shovel was supplied by the Bucyrus Co. in February, 1922, for a Marion (Model 91) shovel owned by the Kelly Island Lime & Transport Co. at its quarry in Marblehead, Ohio. This installation was immediately successful and was followed by a number of others built by the same company. The accompanying list indicates the extent of use of crawler mountings for railroad-type shovels at the present time.

For railroad-type shovels the crawler mounting consists of four units. Two forward units replace the jack arms and are so designed that they can swivel and adjust themselves to unevenness of the ground. Two rear units are mounted on one frame under the end of the shovel. The power is sufficient to enable the shovel to climb a 20-per cent grade. The treads are of cast steel of heavy construction, different sizes being offered to suit the character of the ground on which the shovel operates.



Railroad Type Steam Shovel on Crawler Mounting
On construction of Hudson River bridge and connecting railway south of Albany, N. Y.

RAILROAD TYPE POWER SHOVELS WITH CRAWLER MOUNTINGS

Owner	No. of Crawler Sets	Type of Shovel on Which Installed
Kelly Island Lime & Transport Co.	1	Marion 91
S. A. Smith	1	Bucyrus 70C
Oliver Iron Mining Co.	11	Marion Model 91
Palmer & McBryde	1	Bucyrus 60C (Elec.)
Utah Copper Co.	7	Bucyrus 95C and Marion 91
Atlas Portland Cement Co.	1	Bucyrus 88C
A. E. Dick	1	Bucyrus 70C
Trafikaktiebolaget Grangesburg Oxelosund, Stockholm, Sweden	1	Bucyrus 100C
Central Pa. Quarry Stripping & Const. Co.	1	Marion Model 61
Locust Mt. Coal Co.	1	Bucyrus 70C
France Stone Co.	2	Marion Moeel 92
Chile Exploration Co., Chile	1	Bucyrus 103C (Elec.)
Michigan Limestone & Chemical Co.	1	Marion 100
Sandusky Portland Cement Co.	1	Bucyrus 68C (Elec.)
Kandos Portland Cement Co., Australia	1	Bucyrus 68C (Elec.)
Duquesne Sla- Co.	1	Bucyrus 103C
Total	33	

Substantial economies in operation are possible with this type of mounting. The track sections, of course, are discarded and since there are no jacks to release and set, the need of a large pit crew is eliminated. The time required to move up is greatly reduced, as the shovel can travel forward while the dipper is swinging back from the car. This is an item of saving which, in the aggregate, mounts up at the end of a day's work.

With the crawler mounting the shovel can always be kept at the most effective digging distance from the face of the cut. There is no need of reaching out to get a full dipper, and consequently there is less strain on the boom and handle, and increased output. In rock excavation the shovel is not obliged to face blasts with the likelihood of damage, because it takes but a few minutes' time to move back out of the way and up again when the shot is fired. With the crawler mounting it has been noticed that there is considerably less vibration during digging operations, resulting in an increased life of the piping of the shovel.

The mounting of heavy excavating machinery on crawlers is not a new development. The Bucyrus Co. has for the past nine years equipped more than 100 dragline excavators, revolving shovels and tower excavators in this way. The adaptation of the crawlers to the heavy railroad-type shovel is, therefore, an added step in the improvement of excavating machinery that has been in progress during recent years. It is significant that the two largest users of railroad-type steam shovels in the world today, the Oliver Iron Mining Co. and the Utah Copper Co., after purchase and test of crawler mountings, ordered, respectively, 10 and 6 additional sets.

Machinery Export Plans for 1923—Latin America

Conditions Changed Since War—Exports to Latin American Group Totaled $92,000,000 in 1920

By W. H. Rastall
Chief, Industrial Machinery Division, U. S. Department of Commerce

This is the second of a series of articles on Foreign Machinery Markets. The first one appeared in "Engineering News-Record," Feb. 8, 1922, p. 279.—Editor.

AN ARTICLE published in *Engineering News-Record*, Feb. 8, p. 279, outlined the foreign-sales problem for the current year in its more general aspects. With that article was published a table showing the comparative value of the more important machinery markets of the world, as indicated by American export statistics for 1921, 1919, and 1910, and attention was drawn to the fact that of the 20 leading countries 17 were largely free from reconstruction problems and similar troubles resulting from the war. The present article is devoted to the countries in Latin America that were shown by the previous table to rank high as markets for American industrial machine.

Transportation routes, as at present developed, make it desirable to divide the entire Latin American territory into three groups; namely, Mexico and Central America, the West Indies and the countries bordering on the Caribbean, and other countries in South America proper. The comparative importance of these markets has changed since before the war. The nature of these changes is indicated in Table I, from which it will be noted that the machinery exports from the United States to the entire Latin American group expanded from about $15,000,000 in 1910 to $105,000,000 in 1920, falling to $92,000,000 in 1921. The percentage of the total exports of American industrial machinery absorbed by the markets of Latin America fell from about 30 per cent in 1910 to 15 per cent in 1915, but expanded to 37.4 per cent in 1921, at which time the trade was very evenly divided among the three groups of countries.

German and British Trade

Unfortunately the statistics published by the different Latin American governments do not provide a great deal of assistance to the American exporter in solving his problem, as in many cases the classifications employed scarcely meet his needs. In pre-war days German manufacturers secured better returns from the markets of Latin America than from any other

part of the world, and British manufacturers have secured important business from these markets for many years. Because of the earlier entry of European interests into this trade, due in part to financial affiliations, these interests secured an exceptional position, largely because American manufacturers had not given the market the necessary attention.

During the war, when many of the Latin American countries were more or less cut off from their accustomed sources of supply, new industries were established. In a number of instances these industries have flourished, thus creating a field for the sale of American machinery.

Trade Conditions

Cuba—Although the table published in this journal, Feb. 8, p. 280, indicates that among our foreign markets throughout the entire world Mexico ranked 1, 9, 4, 2, in the years 1921, 1919, 1913, and 1910, respectively while, in the same years, Cuba ranked 3, 5, 6 and 5, the chart accompanying that article shows that since 1915 Cuba has been our best Latin American market, except during unfavorable sugar market years, such as during the last two or three years. However, the price of sugar is now in the neighborhood of 3¾ cents, or perhaps 35 per cent above the 1913 level, so that it would appear that Cuba is well started on the road to recovery. Furthermore, there seems to be reason to discount somewhat the press reports that large quantities of American machinery still remain undelivered at Cuban ports. It has been estimated that the glut of merchandise, which at one time had accumulated in the bonded warehouses of Cuba, has been reduced from the highest total (perhaps $60,000,000 to $80,000,000) to a present total not exceeding $10,000,000 to $15,000,000, and it is, of course, recognized that machinery is only one item of the many classes of merchandise that accumulated there. Conditions in the machinery markets of Cuba well deserve careful attention at this time. In this connection it is interesting to remember that, in spite of recent business disturbances, the Cuban exchange has remained at par.

Mexico—More American machinery was absorbed by Mexico than by any other country in the world in 1921. In spite of unsettled conditions that country for a number of years has been one of our most important markets. It is true that there are certain problems involved in contracting to deliver machinery and receive payment at a Mexican destination, but those manufacturers who arrange to collect before their products cross the border have found their Mexican business very attractive and the volume of such business has been large. The Mexican exchange is very close to par.

Brazil—During the years 1921, 1919, 1913, and 1910 Brazil ranked 9, 10, 5, 9, respectively, among the markets for American machinery, absorbing over $8,700,000 worth in 1921, in spite of the fact that the rates of exchange have been very unsatisfactory. In July, 1913, the milreis was worth 32.45 cents; by July 31, 1920, it had fallen to 21.6 cents; and on November 15, 1922, it was quoted at 11.53 cents. It should be remembered that Brazil is larger than the United States, but its railway mileage is only equal to approximately what was in operation in the United States in 1855. The country is undeveloped and contains wonderful opportunities for development that lead to the purchase of machinery. The population of Brazil is over 30,000,000. The country shows signs of developing rapidly, and appears to have reached the state where it will require large quantities of machinery.

Argentina—Ranked 10, 11, 10, 6 as a market for our machinery in the years 1921, 1919, 1913, and 1910. Exchange, which stood at 43.45 cents to the peso in July, 1913, and was 39.06 cents on July 31, 1920, and 20.125 cents on August 17, 1921, had recovered to 36.1 cents on November 15, 1922. Argentina, though only about one-third the area of Brazil, has a 20 per cent greater railway mileage, with a population of about 8,500,000.

Peru—Among the markets for American machinery Peru ranked 14, 20, 19, 21 in the years 1921, 1919, 1913, and 1910. In July, 1913, the Peruvian pound had an exchange value close to parity. On July 31, 1920, it was worth $3.65, and on November 15, 1922, had recovered to $3.91. Peru took more machinery than South Africa in 1921. At present important railway expansion, irrigation work, and the development of hydro-electric and other utilities are being suggested in Peru, which will require machinery, in addition to the mining demand.

Chile—Ranked 15, 12, 14, 14, respectively, in 1921, 1919, 1913, and 1910. Chilean exchange has been unsatisfactory, although it has improved somewhat recently. To a great degree Chile depends upon the prosperity of the nitrate business. Chile took $5,600,000 worth of American machinery in 1919 and $3,500,000 worth in 1921.

Dominican Republic—In 1921, 1919, 1913, and 1910 the Dominican market ranked 16, 24, 18, 22 in the shipments of American industrial machinery. In 1921 it absorbed $3,250,000 worth.

Colombia—Ranked 18, 25, 21, 24 among our machinery markets. In the interval since 1913 Colombia has placed its currency on a gold basis, so that the exchange problem is no longer important. At present Colombia is an exceptionally promising market, because of the extensive oil operations and the comprehensive railway program.

Venezuela—Ranked 25, 29, 26, 26 in 1921, 1919, 1913, and 1910, but it should be remembered that, although the rank has not changed materially in a decade, the volume of the country's purchases of our machinery has expanded from $110,000 to $1,400,000. Venezuela is a promising market.

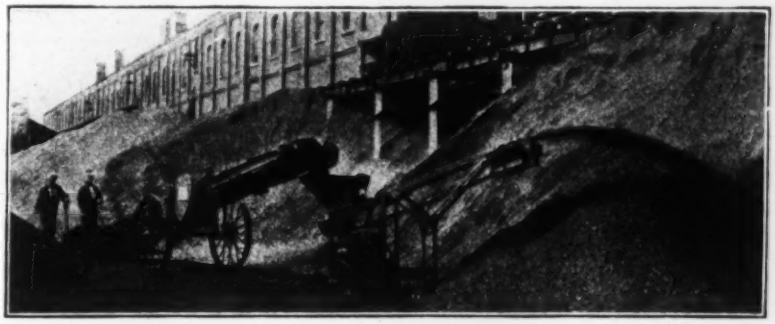
TABLE I—DESTINATION OF INDUSTRIAL MACHINERY EXPORTED FROM THE UNITED STATES

Destination	1910	1913	1915	1919	1920	1921
Canada, Newfoundland, etc.	$14,368,755	$32,740,377	$15,740,484	$57,490,321	$68,534,672	$28,867,066
Europe (except Balkans)	14,151,707	29,117,195	89,790,973	112,178,313	116,848,098	44,844,196
South America	5,553,574	10,690,991	4,606,836	26,180,072	35,787,203	30,631,382
Mexico and Central America	6,914,500	6,433,548	2,858,474	11,450,859	22,293,921	34,381,861
West Indies, etc.	2,923,918	5,375,266	4,466,958	22,248,987	47,087,299	27,146,318
Total Latin America	$15,391,992	$22,499,805	$11,932,268	$59,879,918	$105,168,423	$92,159,561
Asia (except Asia Minor)	3,805,620	6,530,936	4,443,287	73,116,419	71,296,081	64,424,150
Australasia	2,209,862	3,566,129	2,999,898	5,792,748	8,171,153	7,706,546
Africa	1,441,949	1,591,746	1,573,369	5,615,898	7,652,579	4,643,732
Other	119,713	424,884	567,052	6,382,142	5,959,351	3,791,113
Grand total	$51,489,598	$96,471,072	$77,047,331	$320,455,759	$383,630,357	$246,436,364
Percentage to Latin America	29.9	23.3	15.5	18.7	27.5	37.4

Japanese Handle Coal With American Conveyors

Japanese engineers, selecting machinery for their purpose from Link-Belt publications, have made the application shown in accompanying illustration for storing out and reclaiming coal. The coal is so largely of small size or slack that the use of a Pratt box-car loader for building piles of coal does no harm from breakage, as it might with high grade lump coal. The combination of this machine with a portable belt conveyor makes a flexible device for handling coal to and from various parts of the yard.

This combination can be used for handling other bulk materials which would not be injured by the action of the box-car loader. This machine was developed for delivering sand and other materials to the farthest corner of a car, without having the machine itself take up much room or be difficult to manage in a confined space.



American Conveyors, in Tandem, Store Coal in Japanese Yard

More Suggestions—

For Better Equipment and Repair Parts Service

IN the Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of steel forms, buckets and steel buildings.

From the Blaw-Knox Co., Pittsburgh, Pa.

THE Blaw-Knox Co. runs a rather more elaborate service department than is customary with the average manfacturer. For example, we have service men constantly on the road who inspect our clamshell buckets, instruct operators, give us a full report of the condition of buckets, and bring our service to the attention of the owner.

The use of a clamshell bucket for purposes for which it was not manufactured results either in the failure of the bucket to function properly or a large upkeep cost over a comparatively short period. There is no such thing as a universal clamshell bucket—that is, one that will do everything efficiently. This company makes buckets for every variety of work, some of which will do a greater variety of work than others, but each has its particular work and construction features. We have found many instances of buckets made to handle some loose bulk material being utilized for heavy excavation. Of course, the bucket does not function properly in this use.

It would appear that education, which must be of an extremely varied character, is the only solution for this problem, but the owner and manufacturer both suffer, because at times the conscientious manufacturer, endeavoring to meet his customer's problem, is somewhat higher in price than a competitor who is using as his basis of figuring a bucket not adapted to meet the special conditions. Of course, where you know that such conditions exist they can be met by proper salesmanship, but there are many instances where an order is lost and the exact reason for its being lost does not become known until it is too late.

The placing of orders for road forms for immediate delivery during the height of the road-building season is something which we, in common with other manufacturers, experience. In some instances, of course, such action is necessary, but it is believed that the great majority of orders for last minute shipment could be anticipated and the manufacturing curve stabilized along a straighter line than exists at present. Naturally, the user suffers in two ways: (1) He cannot obtain his equipment in time for the job and is obliged to use either a makeshift or a grade of equipment which is not efficient. (2) There is a question of price balance which could possibly result in a slight reduction if the manufacturer could figure with more or less exactitude on a certain manufacturing program, carrying a steady load through divisions of his shop during all months of the year.

The contractor would be much better served if he were always specific in orders for repair parts. We have, however, so systematized our work along these lines, that we are able to furnish in the majority of cases, the right part for the right apparatus without receiving a great number of details to the apparatus itself. This, however, represents a high degree of efficiency on the part of our organization and does not excuse the contractor from his duty to the manufacturer.

A definite plan of plant inspection on the job by the contractor would result in greatly increased efficiency. Some contractors exhibit great acumen in observing the fine details of plant inspection, and have a very well developed mechanical sense which enables them to put together apparatus which is more or less complicated without the use of manufacturer's drawings. As is always the case, you will find that these contractors are the most successful in their lines and have the best and most up-to-date equipment. On the other hand, you often run into cases where the contractor will "holler for help," and of course, we send our service men and give him the required assistance.

The more the contractor understands the manufacturer's problems, the greater the contractor's own efficiency will become. Co-operation will be reflected both in the price and the quality of the manufacturer's products.

Business Notes

ADENSITE CO., INC., New York City, has recently been formed for the manufacture of a liquid integral compounded from calcium chloride, gums and other carbon compounds, for use in the making of Portland cement concrete and mortar. John R. Lapham, professor of civil engineering in George Washington University, Washington, D. C., is in charge of the laboratory tests carried on with Adensite. William C. Kober and Thomas Moore, both formerly with the Anti-Hydro Waterproofing Co., are active in the management of the new company. Both Mr. Kober and Mr. Moore have poured concrete on the job and their outlook is not limited to the laboratory. The Adensite Co. will specialize in concrete texture, keeping absolutely out of all problems that are in the province of the structural engineer.

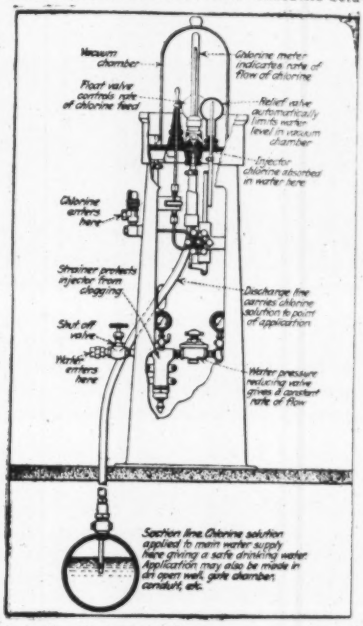
AMERICAN INTERNATIONAL CORP., New York, has announced the resignations of Frank A. Vanderlip as chairman of the board of directors and Charles A. Stone as president. M. C. Brush, senior vice-president, has been elected chairman of the executive committee and president. Gordon H. Balch has been elected a vice-president.

EASTON CAR & CONSTRUCTION CO., makers of cars, track and equipment for industrial purposes, as well as Easton roll-over and scoop bodies for trucks and other similar equipment, announces the opening of a new office in Harrisburg, Pa. The office will be under the personal direction of GEORGE D. FRAUNFELDER.

Equipment and Materials

Apparatus for Chlorinating Water and Sewage Has New Control

The largest installation of chlorine control apparatus in the world is now at the Westerly Sewage Disposal Plant Cleveland, Ohio, where six W@T Type MSV chlorinators of a total capacity of 3,960 lb. of chlorine per 24 hours, are in operation. This type of chlorinator has only recently been perfected by the Wallace & Tiernan Co., Inc., Newark, N. J., and represents a new principle in chlorine control. Sturdiness of construction, simplicity of operation and elimination of small delicate parts have been sought in the design. The chlorine gas, from the time it enters the apparatus until it is made into chlorine solution, is always under a vacuum so that the possibility of leaks is reduced to a minimum. Furthermore, the flow of chlorine automatically ceases whenever the water supply to the apparatus is shut off.


Vacuum chamber
Chlorine meter indicates rate of flow of chlorine
Float valve controls rate of chlorine feed
Relief valve automatically limits water level in vacuum chamber
Injector chlorine absorbed in water here
Chlorine enters here
Strainer protects injector from clogging
Discharge line carries chlorine solution to point of application
Shut off valve
Water enters here
Water pressure reducing valve gives a constant rate of flow
Section line Chlorine solution applied to main water supply here giving a safe drinking water Application may also be made in an open well, gate chamber, conduit, etc.

The chlorine is controlled by the vacuum produced by an auxiliary supply of water flowing through an injector, the vacuum drawing the chlorine into the injector where it is mixed with the auxiliary water supply. The chlorine solution thus formed is conveyed to the water supply to be chlorinated.

The auxiliary water supply first passes through a strainer and then through a reducing valve to the injector. The suction created by the water passing through the injector is transmitted through a silver adjustable head tube to the inside of a glass bell jar which stands in a partly filled tray of water. The vacuum created causes the level of the water inside the bell jar to rise above the water level outside the jar. This opens a float reducing valve which allows the chlorine to enter the bell jar, the chlorine cylinder being connected directly to the feed line to which this float valve is attached.

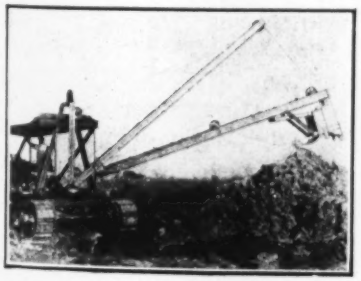
A glass meter tube with a calibrated orifice at the top fits over the silver adjustable head tube. Connection through several small ports is made from the inside of the meter tube to the inside of the bell jar so that normally water levels in both would be equal. The only way that the chlorine can enter the injector is through the orifice at the top of the meter tube and down through the silver tube. Since the flow of gas through an orifice depends on the drop in pressure across the orifice, it is only necessary to measure this drop to know the flow of gas at any time. The water level inside the meter tube can be adjusted by varying the elevation of the adjustable head tube inside the meter and the chlorine flow regulated in this manner. The pressure drop across the orifice is equal to the difference in height of the water inside the bell jar and inside the meter tube. The orifice meter tube is empirically calibrated to convert this difference to pounds of chlorine per 24 hr. A ratchet arrangement enables the adjustable head tube to be set as desired.

The chlorine then goes down into the injector where it mixes thoroughly with the water and then passes to the point of application through the discharge line.

New Trench-Digging Attachment for Locomotive Crane

The range of application of its Model 16 crane, on which interchangeability features are provided for clamshell bucket, power shovel, dragline, and hook and block operation, has been extended by the Bay City Dredge Works, Bay City, Mich., in the form of a new ditcher attachment, illustrated in the accompanying photograph. This is not a new machine, but consists merely of an auxiliary boom attached to the standard clamshell or dragline boom, with a dipper of the power shovel type mounted on its under side.

The device will dig a trench up to 5 ft. in depth and of variable widths, depending upon the width of the ditcher scoop. The weight of the boom, the manufacturers point out, may be transferred to the bucket, making it possible to dig very hard material. In operation the scoop digs toward the machine, making it possible for the latter to remain on solid ground instead of spanning the trench. The auxiliary boom, it is stated, can be removed in



about an hour's time and a standard boom with clamshell bucket substituted.

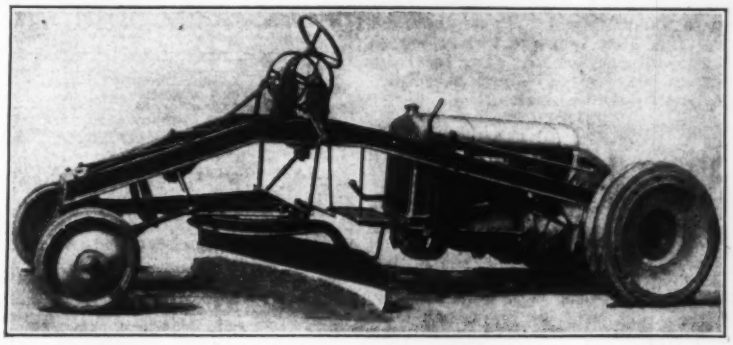
The features of the machine, other than the digging attachment, are a two-speed propelling arrangement for the caterpillar trucks, providing speeds of ¾ and 2 miles per hour. The operator's position is at the front of the machine where he can get a good view of his work at all times.

Road Graders Used for Snow Removal

A wider use of road grading equipment is being developed by adapting it to snow-removal work on city streets and state and county highways. In Peoria, Ill., this winter, the Avery Company's "road razer" was used for clearing snow from the city streets as shown in the accompanying photograph. This type of machine has been employed for the same purpose in Salina, Kansas. The manufacturers of this equipment are emphasizing its all-year-round use-

fulness for highway maintenance and construction purposes in summer and snow removal in winter.

In the city of West Allis, Wis., the Commissioner of Streets has been using



for both road work and snow removal a one-man power grader manufactured by the Wehr Co., Milwaukee. This machine consists of a 6-ft. blade connected to a frame on which a Fordson tractor power unit is mounted, as shown in the accompanying photograph. The equipment is mounted upon disk wheels equipped with solid rubber tires. To assemble the Wehr grader and Fordson tractor, the tractor axle and wheels are removed and the tractor suspended in the yoke of the grader.

Motor Truck Designed for Road Construction Work

Designed especially for use with a standard 21-E paving mixer, the "Road Builder" truck manufactured by the Ruggles Motor Truck Co., Saginaw, Mich., has a two-batch, end-dump body, short wheel base and turning radius, pneumatic tires, and a low gear ratio providing high tractive effort. The gross weight (including chassis, body and load) is 6½ tons and the wheel base is 115 in., resulting in a turning radius of 17 ft.

The truck may be equipped either

with under-body hydraulic hoist and dump body, or automatic gravity end-dump body. For contractors who handle dry aggregate the body is divided by a center swinging partition to handle two five-bag batches. For wet aggregate the center swinging partition is removed. A 2-cu.yd dump body is supplied for handling gravel and earth, together with double-acting tail gate and spreading attachment.

Publications from the Construction Industry

Steel Pipe — NATIONAL TUBE CO., Pittsburgh, has published a 64-page illustrated booklet on the manufacture and uses of Matheson joint pipe, ranging in diameter from 2 to 30 in. The various steps in the process of manufacture are described in detail, the special joint, which is of the bell and spigot type, is illustrated and described, and numerous photographs show applications of the pipe on a variety of projects. One of the advantages claimed for the pipe is the absence of rivets, overlapping seams and ribs, thus improving its hydraulic properties. The joint is ordinarily used for a working pressure of 150 lb. per square inch, but when reinforced by a special clamping device it is suitable for pressures up to 350 lb. Data are given covering the amount of lead required per joint and per mile of pipe. One portion of the booklet deals with protective coatings to prevent corrosion. Tables give the thicknesses and weights of National pipe for various pressures and a comparison with cast-iron pipe.

Feed Water Heater—POWER SPECIALTY CO., New York, describes the Foster economizer in a 32-page illustrated catalog containing, also, a general discussion of boiler-room savings that may be effected by preheating water with waste gases. Results of several tests of these economizers are given and there are tables of the properties of steam.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Lumber Exports Gain 27 Per Cent in Year

Principal Softwood and All Hardwood Exports Increased—British Lumber Trade Improved

The 1922 lumber export trade shows considerable improvement over the preceding year, according to reports of the Lumber Division Chief, United States Department of Commerce, Feb. 19, 1923. The report, in part, is as follows:

"In 1922 our total exports of lumber amounted to 1,532,934,000 ft. b.m., as compared with 1,204,808,000 ft. in 1921, an increase of 27 per cent. The 1913 exports of lumber were 2,576,233,000 ft., making the 1922 exports 40 per cent less than 1913.

"The leading wood during the year under review was Douglas fir, of which 614,704,000 ft. were exported abroad. In 1921 the quantity of this wood exported was 455,233,000 ft. The 1922 increase was 35 per cent. The export of Douglas fir in 1913 amounted to 665,295,000 ft. During 1922 nearly one-half the Douglas fir went to Japan, nearly one-fifth to China, and the next largest quantities to Australia and Peru. The 1922 increase was taken by these countries, except Peru, and in addition the United Kingdom, Chile, and British South Africa.

YELLOW PINE SECOND TO DOUGLAS FIR

"The second leading export wood in 1922 was southern yellow pine, 474,258,000 ft. being exported, an increase of about 10 per cent over 432,736,000 ft. in 1921. The 1913 figure was 869,737,000 ft. Nearly one-quarter of the southern yellow pine in 1922 went to Argentina, nearly one-sixth to Cuba, and less amounts of importance to Mexico, United Kingdom, Canada, Spain, and Belgium. A very large increase occurred in the yellow pine exported to Canada over 1921, and the export to Spain was 184 per cent over 1921. However, Mexico took about 60 per cent less.

"In other softwoods, comparing 1921 with 1922, spruce increased about five times to 35,178,000 ft., redwood more than doubled to 33,143,000 ft., white pine increased 78 per cent to 25,811,000 ft., and western yellow pine more than doubled to 8,358,000 ft. However, other softwoods, not specified, declined one-third.

"Oak was the third leading export wood, and the leading hardwood in 1922, increasing by 59 per cent over 1921 to 108,214,000 ft. In 1913, 287,855,000 ft. of oak were exported. Oak exports to United Kingdom increased over 60 per cent to 49,200,000 ft., to Canada over 50 per cent to 32,338,000 ft., and increased amounts also went to Belgium, Argentina, Uruguay, and Spain. Although of small proportion to the total, it is significant that the export of oak to Spain in 1922 was three and one-half times the 1921 export.

"The lumber trade of the United Kingdom showed much improvement during 1922. Imports of lumber of all kinds were approximately 50 per cent greater in volume than in 1921. Not only did this increase go into consumption, but stocks generally were less at the close of the year than at the beginning."

Relation of Lumber Production and Shipments to Normal

The relation of actual weekly production and shipments to normal weekly production, and to seasonal monthly production and shipments, is shown in the accompanying charts.

The year 1922 began with a production rate of about 50 per cent of normal and ended at approximately the same level. Throughout the entire year the output came within a fraction of normal on only three occasions, namely, the last weeks in May and August and the second week in October, 1922.

Shipments at the outset of the year 1922 were about 60 per cent of normal production, rising to a point as high as 10 per cent above normal during April, May and June and dropping to around 80 per cent at the close of the year.

The closed curved line on both charts shows the relations of actual weekly production and shipments, respectively, to normal weekly production. The broken curved line in Chart I shows monthly and seasonal variation in production in relation to average production. The same line in Chart II depicts monthly and seasonal variation in shipments in relation to average shipments. In other words May and August have been found to be the seasonal peaks in lumber output and shipments in each year since 1912. Similarly, December, January and February are the low points. Average production centers around 76 per cent of normal, and average shipments, about 73 per cent of normal production.

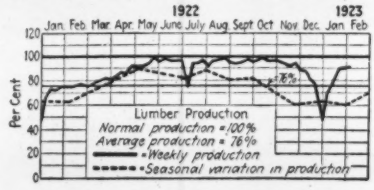


CHART I—LUMBER PRODUCTION

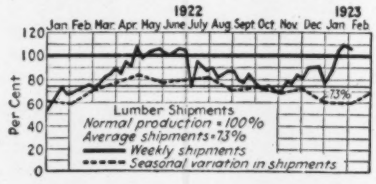


CHART II—LUMBER SHIPMENTS

The National Lumber Trade Barometer, Feb. 16, 1923, shows production at 13 per cent below normal; orders 116 per cent and shipments 105 per cent of normal production.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 95 to 108, are the following:

Waterworks, Wynnewood, Okla., bids received by city clerk, $85,000.

Sewer, Springwells, Mich., bids received by city clerk, $70,000.

Bridges, Columbus, Kan., for Com'rs Cherokee Co., $150,000.

Grading and paving, 16,000 sq.yd. of street, Royal Oak, Mich., for H. P. Oliver Land Co., $70,000.

Factory addition, Chicago, Ill., for Geib and Schafer, $200,000.

School, New York, N. Y., for Board of Education, 500 Park Ave., $750,000.

Bulkhead and pier, Baltimore, Md., for Consolidated Gas, Electric Light and Power Co., $100,000.

Apartment, Chicago, Ill., by W. W. Ahlschlager, arch't., 65 E. Huron St., $2,100,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 95 to 108, are the following projects:

Installing water mains, Cleveland, O., to Gantose Construction Co., $176,647.

Sewer, Pittsburgh, Kan., to Beeson Machinery Co., Kansas City, Mo., $98,801.

Bridge, Burnham, Ill., to Strobel Steel Construction Co., Chicago, $173,462.

Canal, Merced, Calif., to C. R. Adams, Planada, $94,120.

Paving 6,600 yd., 2-in. rock asphalt on 5-in. base, Oklahoma City, Okla., to Western Paving Co., $37,029.

Factory, Brooklyn, N. Y., to J. W. Ferguson Co., Paterson, N. J., $500,000.

Hotel, Chicago, Ill., to E. Bloom, $3,500,000.

Natatorium, Annapolis, Md., to Boyle-Robertson Construction Co., $355,858.

Park, Astoria, N. Y., to T. Di Roma, New York, N. Y., $111,903.

Waterworks and street car system, Harbin, Manchuria, to Beckman & Linden Engineering Corporation, San Francisco, Calif., $3,000,000.

Apartment, Long Beach, Calif., to Scofield Engineering Co., Los Angeles, $1,000,000.

Fewer Business Failures

The reports of failures received by *Dun's Review* for the five days ending Feb. 17, indicate that all districts of the United States, except the Pacific, have had small decreases; the Pacific section shows a slight increase. The week's total is 361, as against 371 for the six business days of the previous week. In the five-day week a year ago 610 defaults were reported.

A decrease, both absolutely and proportionately, is evident in the number of insolvencies with liabilities of more than $5,000 in each case; this week they number 198, or 54.8 per cent of the total, while for the week preceding they aggregated 220, or 59.3 per cent.

Building Trades Labor Rates Advanced in Minnesota

Building trades mechanics in Minnesota, during the coming summer, both skilled and unskilled, will receive wages averaging 10 per cent higher than the present scale, according to agreement reached at the annual convention of the Minnesota Building Employers' Association in St. Paul. Fourteen cities are included in the agreement, as follows: Minneapolis, St. Paul, Duluth, Winona, Stillwater, St. Cloud, Mankato, Red Wing, Owatonna, Albert Lea, Austin, Rochester, Fergus Falls and Hibing. It is expected that, as in the past, the rates paid in these leading cities of the state will govern, in the main, the scale to be observed in the state generally. The new scale is to become effective June 1, this arrangement enabling contractors on work now in progress to complete it within original estimates.

The newly established rates per hr. and those now obtaining are:

	New	Present
Bricklayers	$1.12½	$1.00
Plasterers	1.12½	1.00
Stone setters	1.10	1.00
Carpenters, cement finishers, electricians, hoisting engineers, structural iron workers, wood lathers, painters, plumbers, steam-fitters, sheet metal workers, stone masons	.87½	.80
Teams and teamsters	1.05	.95
Mason tenders	.71½	.65
Laborers	.55	.50

In announcing this agreement, the association directed attention to the fact that the present wage scale in the fourteen cities was lower than scales obtaining generally the past year in cities in the northern half of the country. The resolution embodying the new scale stated:

"Be it resolved that in determining wage scales due consideration be given to the highly skilled workmen, and it is our recommendation that such men be paid as a maximum wage in the crafts mentioned the amounts herein shown. In making this recommendation, we urge careful consideration of the principle that workmen be paid according to their skill and efficiency."

Cotton Spindles and Steel Output Gain in Activity

Evidence of further business expansion appeared during the week ending Feb. 17, according to reports received by R. G. Dun and Co. Activities in most quarters steadily gained momentum, and the point has been reached in different instances where results are being compared with the best previous records. No month even in war times saw as many cotton spindles running as was the case this January, and the steel industry has attained practically the highest rate of operation possible under existing conditions. The main problem now, broadly considered, is not one of finding employment for workers, but rather of securing enough men to maintain outputs on the scale warranted by current demands. Some buyers, quicker than others to sense the changed situation, have endeavored to commit themselves heavily with manufacturers, so as to secure protection against future requirements. The policy of not a few producers, however, is one of discouraging over-purchasing, and there is more of a tendency, especially in the steel trade, to look to jobbing channels for sources of supply.

That prices of many commodities are strengthening under pressure of the larger consumption has been clearly shown by Dun's list of wholesale quotations, which has disclosed an excess of advances in every week this year, and reports are becoming more common of premiums being offered to hasten shipments. Difficulty in making prompt deliveries frequently is encountered, owing to storms and cold.

Business Briefs

Call money reached high point of 6 per cent, Feb. 13; low, 4 per cent, Feb. 16. Similar rates prevailed during same week in 1922.

Time loans at maximum of 5 per cent, Feb. 13; low, 4¾ per cent. Same rates in effect Feb. 14, 1922.

Commercial paper at high, 5 per cent, Feb. 13; low, 4½ per cent. Same week, 1922, high, 5 per cent; low, 4¾ per cent.

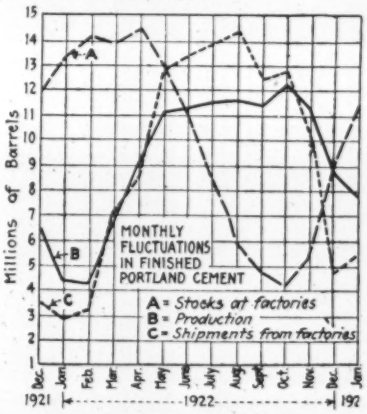
Foreign exchange: Sterling at $4.70¼, Feb. 19, highest since 1919; due to heavy demand for international requirements. Franc, 6.06c.; rise of .95c. in two days. Mark, .0048c., down from .0051½c., Feb. 17.

Money supply for entire country, Feb. 1, shows decline of over $171,000,000 in month, due to retirement of reserve notes.

Cement Output and Shipments Higher Than Year Ago

Cement production and shipments were higher in January than during the corresponding period last year, but reserve stocks at the mills are somewhat lower than the quantity on hand a year ago.

The total output for the country, according to the Geological Survey, was 7,704,000 bbl. for January, 1923, an increase of over 3,000,000 bbl. as compared with January, 1922.



CEMENT OUTPUT, SHIPMENTS AND STOCKS

Shipments during January, 1923, amounted to 5,419,000 bbl., an advance of over 2,000,000 bbl. compared with the corresponding period last year.

Stocks on hand, at mills, Feb. 1, 1923, reached 11,426,000 bbl. as against 13,316,000 bbl. available at the same time last year.

The monthly fluctuations in production, shipments and mill stocks of finished portland cement, throughout the country, are shown in the accompanying chart.

Important Foreign Construction Projects Reported

Progress on a number of important construction projects in foreign countries, is reported by the United States Department of Commerce, Feb. 19, as follows:

Manchuria.—The South Manchuria Railway is reported to have set aside about 7,000,000 square feet of land for the establishment of a hospital, a chemical institute, a bacteriological institute, schools, a museum, etc. (Trade Commissioner Frank Rhea, Peking.))

China.—An American engineering firm has been awarded a contract for repairing a 3-mile break in the dikes of the Yellow River. (Trade Commissioner Frank Rhea, Peking.)

Chile.—The departmental board of railways has asked the Government of Chile for authority to float a loan of 5,000,000 pesos to be used for the construction and improvement of roadways near Santiago. It is understood that this request was well received by the Government. (Assistant Trade Commissioner Embry, Santiago.)

Canada.—It is reported that tenders will shortly be called for the construction of a dam on Lake Kenogami, in the Lake St. John district, Province of Quebec. It is understood that the total investment involved is approximately $2,500,000. Other important work is also being done in this district. (Consul E. Haldeman Dennison, Quebec.)

BIG CUBAN PUBLIC WORKS JOBS

Cuba.—Under the $50,000,000 loan just floated for Cuba, $6,000,000 is set aside for public works. It is anticipated that this sum may be increased should the other items of the appropriation not absorb the full balance of the $50,000,000. Also, the total available for public works will scarcely permit the completion of undertakings already started. More definite particulars will be available later. (Commercial Attaché Edwards, Havana.)

India.—It is reported that the Government consulting engineers have been asked to prepare an estimate of the cost of the cantilever bridge across the Hooghly River at Calcutta. Experimental cylinders on the Calcutta and Howrah sides are being sunk. (Vice Consul Harold Shantz, Calcutta.)

Philippines.—The following items appear in the appropriation bill recently submitted to the legislature: For wireless stations and equipment, $75,000; for maintenance of public buildings, $200,000; for maintenance and improvement of roads and bridges, $1,060,000; for studies regarding public improvements, $120,000, for waterworks, $250,000; for harbor work, $60,000; for telegraph and telephone systems, $120,000; for lighthouses, buoys, and beacons, $50,000. (Manila Daily Bulletin, December 13.)

France. — The Supreme Railroad Council has approved of reconstruction work on the important French railways, totaling 1,045,000,000 francs. Of this, 270,000,000 francs are for electrification and 775,000,000 francs for general construction work. (Ambassador Myron T. Herrick, Paris.)

West Indies.—The Government of Trinidad and Tobago has obtained sanction for a scheme to supply water to the southwestern portion of the island of Tobago, including the towns of Scarborough and Plymouth. The

sum of $359,000 is involved, which will be taken from the loan raised in 1920. The construction of this system will be under the direction of the public works department of the government of Trinidad and Tobago at Port of Spain, (Consul Henry D. Baker, Trinidad.)

South Africa.—The harbor advisory board of Port Natal has suggested that the main wharf of Durban harbor be extended 1,300 feet. Recommendation has been approved by the government, and plans and estimates will be made. This board has also recommended the construction of a coaling station to store between 70,000 and 80,000 tons of coal, but this has not yet been sanctioned and plans have not yet been prepared. Consul Lewis V. Boyle, Durban, Natal.)

Switzerland.—A large electric power company has just floated a loan of 6,000,000 francs to be used for the construction and extension of the electric-power and distributing systems in Switzerland. (Consul James J. Murphy, Jr., Lucerne.)

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 1; the next, on March 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.29	$3.95	$4.40	$3.05	$3.30	$3.95	$3.35	$3.80	$3.75
Structural rivets, 100 lb.	3.85	4.60	5.25	3.75	4.00	4.95	4.75	4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.19	3.85	3.15	2.95	3.20	3.62½	3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	51%	53%	45%	59½%	55-5%	38%	38.2@46.5%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	+56.50	+51.00	+57.00	53.20	58.50	65.00	57.00	57.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.60@2.70	2.75	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.00	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+63.00	37.00	+53.00	56.50	+43.75	—51.00	+40.00	29.00	95.00
Lime, finishing, hydrated, ton.	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.85	2.50	1.40	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000.	23.50	12.00	11.00	11.00	17@19	12.00	15.50	13.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.99	1.02	+1.10	1.02	+1.09	+1.21	+1.09	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	.....	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour.	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.80). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

With the present finished steel market in an unusually firm position, due to recent heavy deliveries and an active demand, the absolute minimum on steel bars and structural shapes is placed at $2.15 per 100 lb., Pittsburgh; plates at $2.20. These quotations, however, apply on heavy contract tonnages only. Premiums for specified deliveries bring out quotations of $2.25 on shapes and bars and $2.25@$2.35 for plates. The market on structurals is particularly strong; inquiries indicating an active spring demand. Continued buying of steel for railway car building, together with increased demand for plates, in oil-storage tank construction, feature the current market.

Although the Birmingham base price of $43 per ton on 6-in. cast-iron pipe still holds firm, the tendency is upward in the dealers' warehouses. New York quotes $56.50 as against $56 per ton; Dallas, $57 as compared with $56 per ton, one week ago.

The current lumber market is very active, particularly in long leaf yellow pine for car construction. Mills report the heaviest bookings since 1916, with a scarcity of freight cars. Production, however, is very heavy with reserve stocks somewhat limited.

New York quotes rise of $2 per M ft. in long leaf yellow pine, structural sizes, during week. Price now $63, delivered, for3x12 pine in 20 ft. lengths, as against $61 per M ft. b.m., one week ago. Dallas reports rise of $3 in yellow pine and San Francisco, $4 per M ft. in Douglas fir.

The stiffening of linseed oil prices reflects the general upward tendency in nearly all paint materials. Raw oil, in 5 bbl. lots, is quoted at $1.10 in Dallas, up from $1.07; $1.21 in Denver (wooden bbl.); advanced from $1.19 and $1.09 in San Francisco, as against $1.04 per gal., one week ago.

Despite advances in iron, steel and clay products, lumber, linseed oil and other important construction materials, the prices of brick and cement remained fairly stable during the week, throughout the entire country.

Although the New York brick supply from the Hudson River district is cut off by ice, the supply in reserve at the plants is sufficient to meet all requirements when navigation opens up in the early spring.

The present price of $20 per M, wholesale, alongside dock has continued firm since the first of the year, but the anticipated seasonal demand is preventing manufacturers from covering deliveries at the current prices